GRANULAR AGGREGATE RESOURCES OF ROLLINGDAM (NTS 21 G/6) AND ST. STEPHEN (NTS 21 G/3)

Mineral Resources Division
Department of Natural Resources
New Brunswick

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RESUME

Cette étude, entreprise dans le cadre de l'Entente auxiliaire de mise en valeur des minéraux et des combustibles Canada-Nouveau-Brunswick a pour but premier de cartographier à l'échelle de 1:50,000 les dépôts meubles de sable et gravier dans la région correspondant aux feuillets topographiques 21 G/3 (St. Stephen) et 21 G/6 (Rollingdam). Les cartes sont accompagnées d'un rapport décrivant brièvement le contexte géologique, les méthodes de travail ainsi que les caractéristiques principales des différents types de dépôts meubles. Une évaluation sommaire du potentiel économique de ces dépôts est présentée et des feuilles de chantier complémentent les cartes en fournissant de plus amples détails sur les principaux dépôts.

La région présente un relief modéré, pauvre en contrastes et aux collines arrondies, sauf dans la partie sud-est où la présence de roches cristallines et volcaniques rend la surface un peu plus accidentée. De nombreuses formes d'érosion et de déposition marquent le passage des glaciers wisconsiniens. Lors du retrait des glaces, des systèmes d'eskers ainsi que des complexes fluvio-glaciaires furent laissés en place. La submersion marine qui accompagna le retrait des glaces, remania et modifia plusieurs de ces dépôts glaciaires.

La presque totalité des réserves de sable et gravier se retrouvent à l'intérieur de deux types de dépôts glaciaires: les eskers et les complexes d'épandage fluvio-glaciaire. On évalue à environ 22 million m^3 le volume des ressources disponibles de sable et gravier.

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INTRODUCTION

The present study:

This report summarizes the results and findings of field investigations undertaken during the summer of 1981. The objective of this study is to provide basic information on the distribution, extent, thickness, and quality characteristics of granular aggregate deposits in the St. Stephen centered region. This information will be of help to both producers and consumers of granular aggregates in their search for workable deposits, as well as land-use planners concerned with efficient resource utilization.

The work was funded under the Minerals and Fuels Subsidiary Agreement of the Canada-New Brunswick General Development Agreement.

Location of the study area:

The area under investigation covers approximately 1400 km^2 and is situated in southwest New Brunswick. It is bounded by latitude 45°30' North, longitude 67°00' West, by the waters of Passamaquoddy Bay and by the Ste-Croix River (Figure 1).

Previous geological work:

Early work on the surficial geology of the area was done by Hind (1865), Mathew (1878) and Chalmers (1890). More recently, Gadd (1969, 1973) completed a regional study of the Quaternary geology of southwestern New Brunswick at the 1:250,000 scale. His work included the present map-area with an emphasis on the

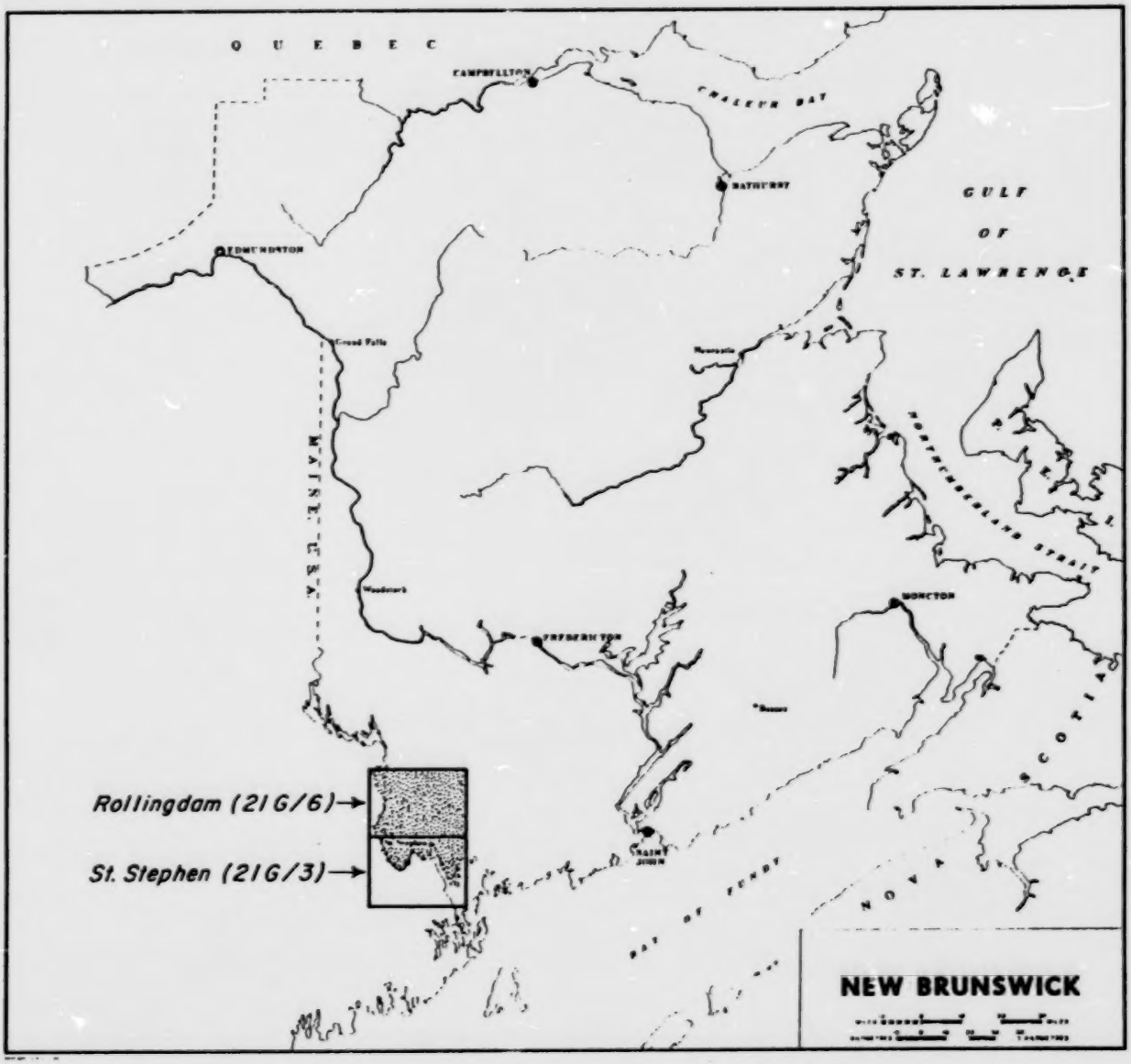


Figure 1: Map showing location of study area

regional patterns of deglaciation.

The bedrock geology of the map-area has been investigated by MacKenzie (1940, 1960a, b) and by Ruitenberg (1968). Several other individuals have studied parts of the area and published maps at various scales. These maps and reports are referenced in the Mineral Resources Branch, List of Publications (Carroll, 1977).

PHYSIOGRAPHY

The area is located within the St. Croix Highlands, a physiographic subdivision of the New Brunswick Highlands. The New Brunswick Highlands are U-shaped with the western arm covering much of the central part of the province, and the eastern arm, including the St. Croix Highlands, bordering the Bay of Fundy (King, 1972).

The relief of the area is moderate, consisting of rounded hills and ridges generally not rising more than 50 to 100 m above intervening wide valleys. In the southeastern part of the map-area, volcanic and intrusive rocks combine to produce a more contrasted landscape and steeper hills.

Glacial erosion and deposition contributed much to the modern landscape but the main character of the pre-glacial landscape has been kept.

The hydrographic network of the map-area reflects ice-controlled late-glacial drainage (Gadd, 1973). The Digdeguash and the St. Croix Rivers are the main streams. The Digdeguash is underfit and parallels a major glacial outwash and esker system.

The St. Croix follows an irregular path marked by lake basins, sharp channel bends and falls near its mouth. The pre-glacial St. Croix River may have taken a more southeasterly route to Passamaquoddy Bay, continuing into Maine (USA) near Upper Mills, in a valley now partially filled by glaciofluvial sediments.

Secondary water courses include the Mohannes and Dennis Streams, and the Waweig and Canoose Rivers. Lakes are uncommon except in the southeastern portion of the map-area, where they occupy numerous depressions in the intrusive and volcanic bedrock terrane.

GEOLOGY

Bedrock:

The bedrock geology is given in Figure 2 which shows the location, age, and characteristics of the various geologic formations.

The bedrock is largely of sedimentary origin and consists principally of greywacke, slate, siltstone, sandstone and quartzite of Paleozoic age. Felsic and mafic intrusive rocks that occur in the southern part of the map-area are part of the St. Stephen igneous complex, believed to be of Ordovician age (Ruitenberg, 1967). Volcanic rocks are found in association with the sedimentary units but occur predominantly only in the vicinity of Chamcook Lake.

The most prominent fault in the region is the Oak Bay Fault which offsets the Ordovician-Silurian unconformity nearly 4 km (Ruitenberg and McCutcheon, 1979). A south-dipping thrust fault

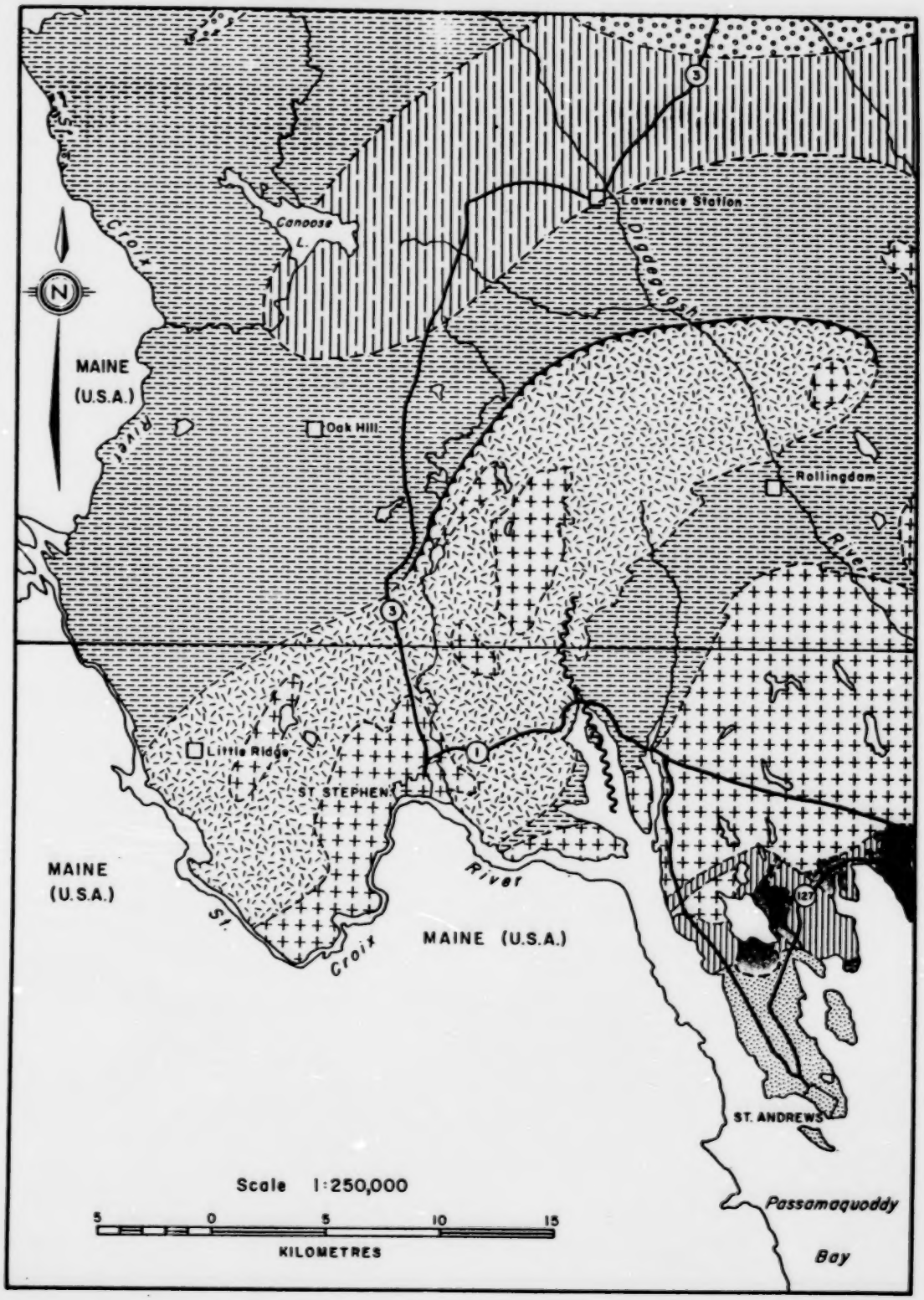
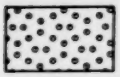


Figure 2: Bedrock geology modified after Potter et al (1979)

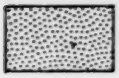
BEDROCK GEOLOGY MAP - LEGEND

MISSISSIPIAN AND/OR PENNSYLVANIAN



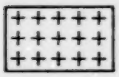
Red to grey conglomerate, siltstone

MISSISSIPIAN (MAINLY)

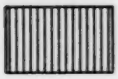


Red to grey sandstone, conglomerate, shale; minor limestone and volcanic rocks

DEVONIAN (TO ORDOVICIAN)



Intrusive rocks: granite, quartz monzonite, granodiorite and related rocks; gabbro, diabase, diorite; peridotite and gabbro of Ordovician or younger age



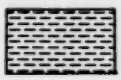
Shale, limestone, sandstone; minor greywacke, tuff and volcanic rocks

SILURIAN AND DEVONIAN

Greywacke and slate; sandstone and conglomerate; minor volcanic rocks

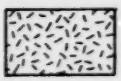
Rhyolite, trachyte, tuff; andesitic and basaltic flows; related intrusive rocks

SILURIAN



Greywacke, slate, siltstone, conglomerate and limestone; minor ferruginous and manganiferous chert and argilite; minor volcanic rocks

ORDOVICIAN (MAINLY)



Argillaceous sedimentary rocks, greywacke, quartzite, conglomerate, minor ferruginous, manganiferous and carbonaceous chert and argillite; minor limestone, tuff and volcanic flows

Geological boundary

Thrust fault

Oak Bay fault

separates the Ordovician and the Silurian in the Rolling Dam area (Ruitenberg and McCutcheon, 1979). Several quarries have been operated in the area but none were active in 1981. Building and ornamental stone have been obtained from granite quarries on or around Bald Hill, 7 km east of St. Stephen (Parks, 1914).

Surficial:

Abundant evidence of glacial abrasion and deposition attests to the complete glaciation of the map-area during one or more glacial stages of the Pleistocene Epoch. Most unconsolidated deposits in the area appear to have resulted from Wisconsin or post-Wisconsin processes as no interglacial deposits have yet been reported.

The principal direction of ice flow in the map-area is well recorded by southeasterly trending drumlins, drumlinoid ridges and by striations. Ice-sculptured streamlined forms are well developed, especially in the northwest part of the map-area and between Upper Tower Hill and Elmsville. This southeasterly flow corresponds to the last strong movement of ice across the area and probably indicates the conjugated effect of continental Laurentide ice and a Maine-centered ice cap during the late Wisconsin. An easterly striation recorded near Big Kedron Lake may be related to a late outflow of ice from a Maine-based ice cap after separation of that local centre from the Laurentide continental glacier. Easterly trending striations are better documented north of the map-area (Gadd, 1973, Thibault, 1981, Rampton and Paradis, 1981, Seaman, 1982) and Genes and Newman

(1980) have suggested a middle Wisconsin age for a subsurface till with an east-west fabric in northern Maine.

Cross-cutting relationships with respect to the dominant southeast flow were noted in only two cases: 1) at G6-25, where the 205° striation may relate to late (possibly floating) ice, and 2) on Ministers Island, where a 190° direction has been recorded. The latter's significance is not clear but it is thought to reflect re-equilibration of a late lobe of ice in Passamaquoddy Bay.

Beginning approximately 15,300 years B.P. (Borns and Hughes, 1977), the margin of the Laurentide ice sheet retreated across the Gulf of Maine from its maximum extent on the continental shelf. Initially, in early postglacial time, sea level at the continental margin was about 120 m lower than at present so that the outer shelf banks stood out as large islands and great extensions of landmass. At the same time, on the Maine and New Brunswick coasts, relative sea level was 70 m higher because of isostatic depression of the land (Grant, 1980). Thus, the Gulf of Maine was a semi-enclosed, almost tideless body of water (named the De Geer sea by Lougee, 1953) which had only a narrow connection to the Atlantic Ocean (Grant, 1980). The presence of the sea and calving bay dynamics (Thomas, 1977) accelerated the melting of an ice lobe that extended into Passamaquoddy Bay (Gadd, 1973). This lobe gradually retreated up the St. Croix River valley, marking its former positions by leaving ice-contact deposits at Sandy Point (G3-24), near Benson Corner (G3-18, 19, 20) and on the east side of Oak Bay (G3-21). Ice margin recession and sea level rise were contemporaneous. Field evidence suggests that the maximum

submergence limit in the map-area (Figure 3) was between 60 m and 70 m above mean sea level (a.m.s.l.). This is based on the occurrence of two major outwash deposits built to similar base levels of between 60 m and 70 m:at 1) Maxwell Crossing (G3-12, 13, 14) and 2) between Rolling Dam and Elmsville (G6-12, 13, 14, 20). Ice-contact deposits located below this limit commonly show evidence of marine reworking: esker crests are subdued and material has been redistributed along the flanks of eskers. Fine silt and clay, in places fossiliferous, also occur below this limit. A new fossil locality (G3-4) indicates a minimum submergence limit of 55 m a.m.s.l. (aneroid barometer).

The coastal area was thus free of ice by 12,300 years B.P. (Gadd, 1973). By that time, the influence of Laurentide ice had ceased because of the opening of a calving bay in the St. Lawrence River valley (Borns, 1977). Deglaciation inland continued, mainly through ice stagnation, although Gadd (1969) believes that a very weak residual southeasterly flow persisted. Esker systems and associated glaciofluvial outwash trace the path of this gradual retreat. As the ice thinned, local topographic features, such as the arcuate series of hills extending from Pomeroy Ridge to Sorrel Ridge, effectively intercepted the flow of ice. Moderate to high relief, irregularly mounded and deeply pitted, non-oriented hummocky moraines, such as the Tryon Settlement moraine, accumulated behind these obstacles as a result of glacier stagnation and disintegration.

During the postglacial, surfaces uncovered by glacier ice and water were subjected to weathering and soil formation (cf.

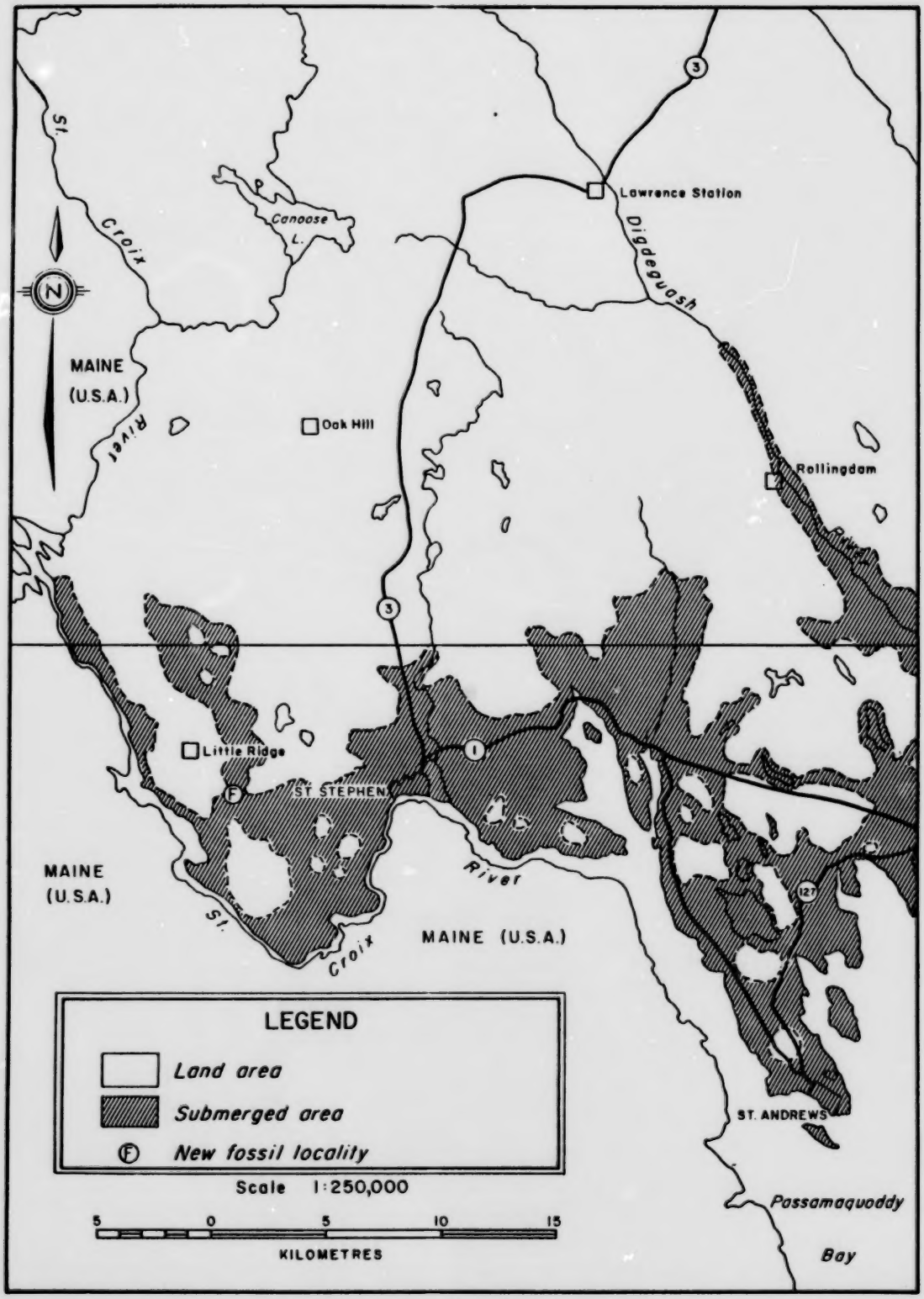


Figure 3: Marine limit in southwestern New Brunswick

Wicklund and Langmaid, 1953). In many flatter areas, swales and depressions, poor drainage and impervious soils have caused paludification of the landscape and the development of bogs and peatlands (Rampton and Paradis, 1981). Most streams have developed narrow terraces and floodpains.

GRANULAR AGGREGATE RESOURCES

Field and laboratory methods:

Information used in the determination of deposit boundaries and thicknesses was obtained by the examination of gravel pit faces and all other natural and man-made exposures that were encountered. Several exposures were made or improved by the use of shovels and hand-augering equipment.

Samples of granular materials were collected from available exposures with a sample site distribution designed to provide a reliable assessment of material qualities in the major deposits. Care was taken to obtain samples that were as representative as possible. Several samples were subjected to wet-sieve analysis to accurately determine the proportion of fine particles (less than 75μm). Supplementary data obtained from the Department of Transportation (D.O.T.) were included in the Appendices. It includes subsurface data obtained from augering operations and laboratory results of various tests performed on the granular aggregate material.

The average material depths used for volume calculations were arrived at by projecting the depths observed in pit excavations

to areas beyond the pit boundaries, with the aid of geologic and topographic observations on the ground and from a study of the aerial photographs. Hammer seismic profiles were used in some cases to aid in determining material thickness (see Appendix A). Confidence in reserve figures is affected by the reliability of material thickness data and of deposit boundaries. In no case can reserve figures be absolutely definitive. Traditional exploration methods, including detailed test-pitting or drilling with power equipment, are always required for accurate evaluation of reserves.

Quality limitations:

The potential of many local granular aggregate deposits for use as high specification aggregate is limited by three major factors:

1) Fine particles:

A high content of fine particulate matter (finer than 75μm) renders the material unsuitable for many uses, at least in the pit-run state. Washing can adequately lower the fine content but doing so increases the cost of exploitation.

Ablation till and some ice-contact deposits are specially affected by this condition.

2) Clast lithotypes:

High-specification coarse aggregate should consist of hard, strong, uncoated, durable particles of crushed stone or gravel. Certain lithotypes are in general more resistant to breakdown than others. The lithologic analyses recorded in Appendices B and C divide the lithologic components into two groups according

to whether they are regarded as being sound or unsound. The test is qualitative, being based on the determination of the lithotype of each clast in the sample and on its resistance to disintegration under impact. This test should not be confused with quantitative soundness tests employing sodium or magnesium sulfate (C 88-73, A.S.T.M. 1974).

In general, the quality of the gravel found in a particular granular aggregate deposit will closely be related to the underlying parent bedrock type (Figure 2).

3) Alkali-reactivity:

Fine aggregate for use in concrete that will be subject to frequent wetting, extended exposure to humid atmosphere, or in contact with moist ground should be free of reactivity with alkalis in cement which may produce excessive expansion in, or cause deterioration of, the concrete. Cox (1980) and Haines (1974) have documented alkali-aggregate reactions in New Brunswick concrete.

Sources of granular aggregates:

Three basic types of granular aggregate deposits occur in the study area: 1) ice-contact stratified drift, 2) glaciofluvial outwash and 3) ablation till. The characteristics and mode of occurrence of each of these types of deposit will be described and general comments made as to their suitability as sources of granular aggregate. More detailed information can be found in Appendices B and C. The Appendices include details of test results and are designed to complement the granular aggregate resource

maps (Plates 82-162 and 82-163). Figure 4 shows the location and status of sand and gravel pits located in the map-area.

1) Ice-contact stratified drift:

Glaciofluvial ice-contact deposits account for about 55% of the total volume of granular aggregate found in the map-area (12 million m^3).

These sediments were deposited in direct contact with, or in close proximity to the ice margin. The deposits characteristically comprise well to poorly stratified sand and gravel that may include varying amounts of silt and clay.

Sharp textural differences between adjacent beds of sedimented material are common. These deposits also very often exhibit deformation structures and may contain till inclusions. As such, they reflect the highly fluctuating hydrologic conditions and physical environment which exist in proximity to a melting glacier. Associated landforms that are found in the map-area are eskers and kame terraces.

Eskers can occur as single continuous ridges of uniform dimension, as ridges of varying height and width, or as a series of mounds linked by low ridges. Eskers can also occur in the form of complex systems with tributaries and distributaries. Esker complexes are the primary source of coarse granular aggregate in the study area and have been worked intensively. The probability of locating coarse granular aggregates in these features is moderate, sand usually predominates and considerable textural variability is to be expected.

Kame terraces are glaciofluvial features deposited between

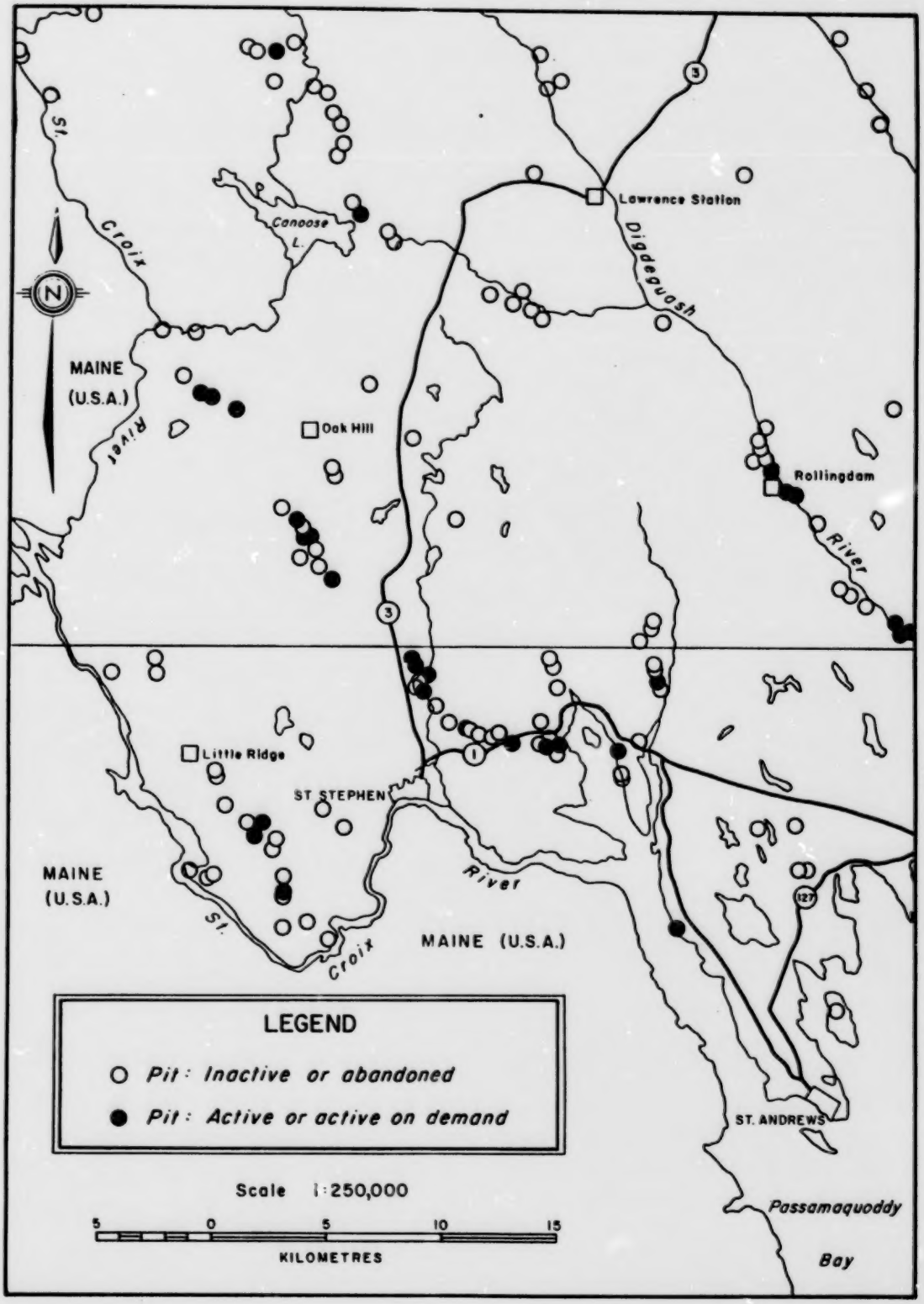


Figure 4: Status of sand and gravel pits in 1981

the glacier and a confining topographic high such as the east side of the St. Croix River valley. These deposits are generally more uniform texturally than eskers. The probability of locating aggregates is high though the quality may be unpredictable.

2) Glaciofluvial outwash:

This consists of sand and gravel deposited by glacial meltwaters beyond the glacier margins. Outwash bodies occur as sheet deposits or as terraced valley fills and may be very large in size. This type of deposit accounts for about 45% of the total volume of granular aggregate found in the map-area (10 million m^3). Well developed outwash deposits have predominantly horizontal bedding, are generally texturally uniform, and clasts are rounded. Less well-developed outwash is more variable in terms of sizing. Proximal (near-ice) units may have ice-contact features. The probability of locating useful granular aggregates is high to moderate.

3) Ablation till:

As a glacier melts, material carried within and atop, slides, flows, is dumped, or subsides onto the ground. The resulting accumulation of loose, non-compact and non-fissile material is termed "ablation till". For the purpose of resource mapping, only the areas where large accumulations of that material existed were mapped. Reserve calculations were not attempted but large and substantial volumes are present within the boundaries of the Tryon Settlement moraine. The material is considered to be low-grade, suitable for use as borrow or subbase, but unsuitable for any high-specification use in its pit-run state. Beneficiation of

such deposits by crushing and washing procedures is a definite possibility although at present this may not be economical or necessary.

4) Minor deposit types:

Alluvial deposits occur along most rivers and streams but not in large accumulations.

Marine deposits occur commonly below the submergence limits (Figure 3) but have little economic potential. A variable thickness of silt and clay drapes the landscape below the 60 m contour line and occurs as an overburden capping on some of the ice-contact deposits. Bricks were made at one time in St. Stephen from these fine marine sediments (Keele, 1914).

CONCLUSIONS

Recoverable reserves of granular aggregate material in the study area are estimated at 22 million m^3. Glaciofluvial ice-contact deposits account for 55% of the estimate and glaciofluvial outwash deposits for 45%.

Reserve estimates do not completely account for the sterilizing effects of various physical, cultural, or economic restrictions which limit or restrict access to these reserves.

Some deposits that were too small to be considered a reserve were not included in the total estimate but may represent valuable resource deposits for local construction and road improvement activity. These small deposits will naturally assume a more important role based upon their proximity to end use. Large accumulations of ablation till specially around Tryon Settlement were not included in the total reserve figure because of the low grade nature of these deposits. They do however represent a good potential source of abundant low grade fill.

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APPENDIX A

HAMMER SEISMIC SURVEYS

1981

In the absence of subsurface data, the hammer-seismic technique has been used locally to determine the thickness of granular aggregate material.

In the table below, the symbol "V" refers to the velocity of an induced seismic wave in a layer of material of thickness "D". Velocities less than 1500 m/sec are interpreted as indicative of sand and gravel. Faster velocities indicate till, clay or bedrock. The study sites are identified by their UTM grid location and corresponding NTS map sheet.

LOCATION	NTS	UTM	V_1	V_2	D_1
A-1	21 G/6	266 227	388	2000	6.6 m
B-1	21 G/6	295 177	919	2733	7.5 m
B-2	21 G/6	298 170	820	2491	5.1 m
B-3	21 G/6	306 173	1054	2630	5.1 m
B-4	21 G/6	305 166	810	2975	6.9 m
B-5	21 G/6	309 160	1048	3400	4.7 m
B-6	21 G/6	316 149	300	2513	1.7 m
B-7	21 G/6	315 135	1100	2712	1.4 m
C-1	21 G/6	429 319	690	2000	2.1 m
D-1	21 G/6	329 308	657	2713	1.7 m
E-1	21 G/6	397 268	778	2333	3.2 m
E-2	21 G/6	401 267	2059	5666	6.7 m
F-1	21 G/6	495 226	500	2769	4.2 m
F-2	21 G/6	501 224	1000	4500	3.2 m
G-1	21 G/6	506 202	375	2778	2.2 m

APPENDIX B

SAMPLE DESCRIPTIONS

OF

ROLLING DAM MAP AREA

21 G/6

Location #:	G6-1	**County:**	Charlotte
Type of Deposit:	Esker	**Parish:**	St. James
Exposure Type:	Pits	**NTS:**	21 G/6
Status:	Abandoned	**UTM:**	247 392

Section Description & Comments:

Two pits have been opened in an esker complex which extends discontinuously northward to Vanceboro, Me. (U.S.A.) and southeastward to the Digdeguash River at Dumbarton. All faces in the pit were heavily slumped and partly overgrown. Maximum recorded face height was 8 m; a sample was collected at the top of the main face in the western pit, where excavation to fresh material showed well sorted sand with few pebbles.

The esker has been heavily worked (estimate: 80,000 m^3) but significant reserves of mainly sandy material remain.

Minor occurrences of sand have been noticed between G6-1 and G6-2. These occur along sections of the "arrow" symbol (see map 21 G/6 in pocket) and may represent esker segments too small to be mapped and/or thin and discontinuous outwash bodies.

Mechanical Analysis:

sieve		1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a	99.1	98.2	96.7	95.4	93.5	89.2	44.6	5.4	2.3	1.1
	b										
	c										

Lithologic Analysis: N.A.

Unsound Lithotypes %	Sound Lithotypes %

Estimation of Reserves:

total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
20	4	3	120,000

Location #:	G6-2	**County:**	Charlotte
Type of Deposit:	Esker	**Parish:**	St. James
Exposure Type:	Pits	**NTS:**	21 G/6
Status:	Active on demand	**UTM:**	288 376

Section Description & Comments:

The pit is active on demand and operated by the Georgia-Pacific Corporation. Various grades of crushed aggregate (5 cm, 2.5 cm, 1.3 cm) and sand have been produced and stockpiled. Pit-run material is also being used.

A large portion of the esker ridge has been mined in the past but substantial reserves of material remain in the southeastern portion of the deposit. Sand and gravel exposed on the main face (10 m high) exhibit classic esker stratification with lateral slumping of the beds. The texture varies vertically and laterally from medium to fine sand to clast-supported cobble gravel. Some boulders were observed within the pit area; the maximum size seen in the section measured 40 cm in diameter. Clasts are subangular to subrounded and less than 5% are coated with manganese. Paleoflow direction of 150° was noted.

Bedrock outcropping along the road leading to G6-2 and a high water table indicate that exploitable material is limited to the esker ridge. Thin and discontinuous outwash sand and pebble gravel is associated with the esker but does not represent an exploitable resource.

Mechanical Analysis:

sieve		1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a	99.2	98.2	88.6	81.6	78.9	76.5	60.4	28.6	8.5	2.4
	b										
	c										

Lithologic Analysis:

Unsound Lithotypes % 31	Sound Lithotypes % 69
Sandstone 18; Siltstone 4; Felsic intrusive 4; Slate 3; Weathered 1; Mafic volcanic 1	Sandstone 41; Felsic intrusive 7; Quartzite 7; Mafic volcanic 4; Felsic volcanic 4; Argillite 3; Mafic intrusive 2; Quartz 1

Estimation of Reserves:

total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
41	6	3	180,000

Location #:	G6-3	**County:**	Charlotte
Type of Deposit:	Esker	**Parish:**	St. James
Exposure Type:	Pits	**NTS:**	21 G/6
Status:	Abandoned	**UTM:**	314 349

Section Description & Comments:

Lower Pit

The main face measures 5 m high and is badly slumped. Sample A was obtained near the top of the section. Debris along the talus slope is cobbly but material exposed near the top of the section consists of well sorted pebbly sand with occasional cobbles or small boulders. A large granite boulder (1.5 m diameter) was noted at the base of the section. The texture is dominantly sandy but pebbles are common. Clasts are generally subrounded to rounded.

Upper pit

All faces were badly slumped and measured an average height of 2.5 m. The texture of the material is similar to that observed in the lower pit but boulders are less common.

Several other small pits and trenches have been opened in the esker ridge and its associated flanking outwash. Reserves are however, limited and of local importance only. Most of the material has been used to upgrade logging roads in the area but a pit, 1.7 km northwest of G6-3, supplied aggregate for the construction of a dam at the outlet of Upper Canoose Flowage.

Maximum relief of the esker is approximately 7 m with some portions of the ridge being very subdued.

Mechanical Analysis:

sieve		1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a	96.1	92.3	84.0	70.2	48.3	33.1	12.1	2.4	1.5	0.9
	b										
	c										

Lithologic Analysis:

Unsound Lithotypes % 27	Sound Lithotypes % 73
Sandstone 16; Weathered 7; Metasediment 2; Chert 1; Slate 1	Sandstone 29; Felsic intrusive 14; Metasediment 13; Argillite 9; Quartzite 4; Felsic volcanic 3; Mafic volcanic 1

Estimation of Reserves:

total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
15	1.5	3	45,000

Location #:	G6-4	**County:**	Charlotte
Type of Deposit:	Esker	**Parish:**	St. James
Exposure Type:	Pits	**NTS:**	21 G/6
Status:	Inactive	**UTM:**	325 311

Section Description & Comments:

A recent excavation in a 3 m face showed 1.5 m of stratified, moderately sorted, loose sand and pebble gravel with some cobbles up to 25 cm in diameter. The clasts were generally subrounded and about 10% were coated with manganese. Slumping obscured the base of the section. The overburden thickness was about 0.5 m.

The esker has been intensively mined and reserves are now largely depleted. D.O.T. (1959, 1968) recommended the material for borrow, subbase and base course aggregate. Samples had a top particle size of 1.2 cm to 1.6 cm and were classified as "1A & 2A" graded aggregate. Test results gave Los Angeles abrasion loss values of 29.1%, 28,2%, 27.0% and 26.4%; the percentage of material finer than the No. 200 mesh ranged between 1.9% and 5.3% with an average value of 2.9%. A hammer-seismic survey indicates limited thicknesses of material below the floor of the pit (in the order of 1.5 m).

A thin and discontinuous apron of outwash (approx. 150 ha) occurs in association with the esker but does not represent a workable source of aggregate.

Mechanical Analysis:

sieve		1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a	93.5	87.7	70.2	57.7	32.3	20.8	9.7	3.9	2.3	1.4
	b										
	c										

Lithologic Analysis:

Unsound Lithotypes % 34	Sound Lithotypes % 66
Sandstone 23; Weathered 7; Slate 3; Chert 1	Sandstone 31; Felsic intrusive 8; Quartzite 8; Argillite 6; Metasediment 6; Mafic intrusive 2; Mafic volcanic 2; Felsic volcanic 2; Quartz 1

Estimation of Reserves:

total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
50			Minimal

Location #:	G6-5	**County:**	Charlotte
Type of Deposit:	Morainic	**Parish:**	Saint James
Exposure Type:	Pit	**NTS:**	21 G/6
Status:	Inactive	**UTM:**	383 274

Section Description & Comments:

In a small pit, faces up to 2.5 m in height showed moderately sorted loose silty sand and gravel, with subangular to subrounded clasts. A nearby roadcut exposed silty sand with pebbles, cobbles and small boulders.

The boundary of the deposit is ill-defined. The relief is low and subdued, and bedrock outcrops are found in the vicinity. This suggests that the thickness of the deposit is variable and probably shallow in general. The texture of the material is probably variable and low grade. Lack of exposures present difficulties in assessing the nature of the deposit; it may be related to the Tryon Settlement moraine.

Mechanical Analysis: N.A.

sieve		1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a										
	b										
	c										

Lithologic Analysis: N.A.

Unsound Lithotypes %	Sound Lithotypes %

Estimation of Reserves:

total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
			Minor

Location #:	G6-6	**County:**	Charlotte
Type of Deposit:	Esker	**Parish:**	St. David
Exposure Type:	Pits	**NTS:**	21 G/6
Status:	Active on demand	**UTM:**	399 268

Section Description & Comments:

D.O.T. has been extracting material from this pit. Although no activity was taking place at time of visit, large stockpiles of crushed aggregate were noted near the pit entrance. Pit faces are low, generally 2 to 3 m of sand and gravel below the present pit floor. Large boulders are rare and the sand to gravel ratio is about 1:1.

A fresh cut displayed the following stratigraphy:

0.5 m Overburden: Oxidized sand and gravel.

1.5 m Sand and Gravel: Stratified sand and gravel beds. The sand is moderately well sorted and cross-bedded (paleocurrent direction of 120°). Thin pebble gravel layers occur within the sand beds. The gravel is moderately sorted and medium to fine in texture, with occasional large pebbles and small cobbles. Clasts are subrounded and commonly platy.

0.5 m Slump-covered: Assumed to be sand and gravel.

The bedding is regular and uniform. The deposit is shallow and remaining reserves are minimal. Material has been obtained in the past from the shallow outwash deposits that flank the esker, but remaining volumes are minimal and extraction depths are limited by proximity to the water table.

Mechanical Analysis:

sieve		1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a	89.9	86.2	74.0	63.1	52.4	41.3	16.5	2.9	1.4	0.8
	b										
	c										

Lithologic Analysis:

Unsound Lithotypes % 48	Sound Lithotypes % 52
Sandstone 23; Weathered 14; Slate 11	Sandstone 22; Metasediment 9; Quartzite 6; Felsic intrusive 4; Mafic intrusive 3; Mafic volcanic 3; Argillite 3; Quartz 2

Estimation of Reserves:

total deposit area (hectares)		area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
Esker	11			Minimal
Outwash	25			

Location #:	G6-7	**County:**	Charlotte
Type of Deposit:	Morainic	**Parish:**	Saint James
Exposure Type:	Pit	**NTS:**	21 G/6
Status:	Abandoned	**UTM:**	403 325

Section Description & Comments:

Several mounds have been tested by D.O.T. in the area but have shown to consist of till and could only be recommended for borrow.

At G6-7, a borrow pit has provided fill material. Testing of the aggregate by D.O.T. (1973) showed Los Angeles abrasion losses ranging from 34.6% to 37.8%; the fine content averaged 15% and grading of the material was poor in all samples. The material was described as a dirty medium sandy gravel with sandy silt and rocks. In places, bedrock was encountered 1.5 m below the surface, and water seepage commonly occurred between 1.2 m and 2.7 m depth.

At least two other sites have been tested by D.O.T. (1973) in the vicinity of G6-7, mainly in relation to low rounded hills. These hills are features of a drumlinized landscape and are not likely to contain any significant volumes of well-graded granular aggregate.

Mechanical Analysis: D.O.T. (1973)

sieve		2"	1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a	93		82	74	66	59		43			16.7
	b			89	78	68	59		39			10.5
	c	97		85	77	69	63		47			17.3

Lithologic Analysis: N.A.

Unsound Lithotypes %	Sound Lithotypes %

Estimation of Reserves:

total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
			Borrow only

Location #:	G6-8	**County:**	Charlotte
Type of Deposit:	Moraine	**Parish:**	Dumbarton
Exposure Type:	Pit	**NTS:**	21 G/6
Status:	Inactive	**UTM:**	529 389

Section Description & Comments:

Opened in an area of hummocky moraine, this pit exposed a 4 m high section showing:

0.3 m Overburden: Soil horizon.

1.7 m Sand and Gravel: Poorly sorted, moderately loose, non-stratified, medium to fine sand with pebbles, cobbles and small boulders up to 80 cm in diameter. An abundance of red sandstones and siltstones was noted. Sand to gravel ratio estimated to be 60:40; texture of the material was very variable and the clasts were angular to subangular.

2.0 m Slump-covered: Assumed to be the same as above.

The only potential usage of this material is for road fill aggregate. Moderate volumes can be found in the area.

Mechanical Analysis:

sieve		1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a	91.4	87.8	75.5	65.0	56.3	48.9	29.4	23.2	12.9	7.1
	b										
	c										

Lithologic Analysis:

Unsound Lithotypes % 43	Sound Lithotypes % 57
Sandstone 30; Siltstone 11; Weathered 1; Chert 1	Sandstone 27; Metasediment 11; Quartzite 9; Felsic intrusive 4; Felsic volcanic 3; Mafic volcanic 1; Quartz 1; Argillite 1

Estimation of Reserves:

total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
56			Moderate

Location #:	G6-9	**County:**	Charlotte
Type of Deposit:	Esker	**Parish:**	Dumbarton
Exposure Type:	Pits	**NTS:**	21 G/6
Status:	Inactive	**UTM:**	549 354

Section Description & Comments:

The following section was exposed in a pit opened at the southern extremity of a long esker that extends along the Magaguadavic valley for 7 km in the map-area:
2.0 m Sand and Gravel: Horizontally stratified and moderately sorted, coarse to medium sand and pebble gravel, in places cobbly. Clasts are subrounded to rounded and there is a significant proportion of deleterious red sandstone and siltstone pebbles in the gravel.
1.0 m Gravel and Sand: Coarse cobbly pebble gravel with small boulders and a coarse pebbly sand matrix; silt proportion is low.
2.0 m Slump Covered: Assumed to be sand and gravel.

The maximum clast diameter observed measured 40 cm. Significant textural variation to be expected.

The pits are now overgrown and abandoned except for the southeastern portion where some activity takes place on local demand. Some outwash has been mapped in association with the esker but since it occurs as a thin and discontinuous mantle, it was not considered a significant resource and no reserve estimates were computed.

Mechanical Analysis:

sieve		1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a	89.0	85.2	71.9	58.4	44.6	30.7	11.5	4.3	1.9	1.1
	b										
	c										

Lithologic Analysis:

Unsound Lithotypes % 58	Sound Lithotypes % 42
Sandstone 30; Siltstone 26; Weathered 2	Sandstone 21; Quartzite 8; Felsic intrusive 5; Metasediment 4; Mafic volcanic 1; Felsic volcanic 1; Quartz 1; Argillite 1

Estimation of Reserves:

total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
80	45	4.5	2 million

Location #:	G6-10	**County:**	Charlotte
Type of Deposit:	Morainic	**Parish:**	Dumbarton
Exposure Type:	Pit	**NTS:**	21 G/6
Status:	Inactive	**UTM:**	557 228

Section Description & Comments:

The pit is very small and now inactive. The material was used as borrow for local lumber road improvement. Sample collected is representative of the material expected to be found in the general area.

The section height averaged 2 m. The material was moderately compact, grey in color and consisted mainly of medium sand with angular to subrounded pebbles. Some small boulders occurred in the vicinity. All grades of texture should be expected; silt is commonly an important constituent.

Mechanical Analysis: WET SIEVE

sieve		1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a	96.0	92.9	82.8	74.7	66.5	60.0	49.9	40.5	30.6	20.3
	b										
	c										

Lithologic Analysis:

Unsound Lithotypes % 14	Sound Lithotypes % 86
Sandstone 7; Slate 2; Metasediment 2; Weathered 1; Siltstone 1; Felsic intrusive 1	Sandstone 40; Metasediment 20; Argillite 15; Quartzite 5; Felsic intrusive 3; Quartz 3

Estimation of Reserves: N.A.

total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable

Location #:	G6-11	County:	Charlotte
Type of Deposit:	Esker	Parish:	Dumbarton
Exposure Type:	Pit	NTS:	21 G/6
Status:	Abandoned	UTM:	495 227

Section Description & Comments:

The site was examined by D.O.T. (1974). A 16 m high pit face, heavily slumped, showed material that varied in texture from clean medium sand to dirty gravel to sandy gravel with cobbles and boulders. The proportion of silt in the samples was low (between 0.9% and 1.5%) and the Los Angeles Abrasion Loss was 30.4%. The material was recommended as a source of borrow, subbase and base course (1¼" crushed) aggregate.

Reserve estimate "A" corresponds to the esker/ice-contact system extending from Dumbarton to Rolling Dam Station (approx. 7 km). The estimate "B" corresponds to an ice-contact deposit located east of the Digdeguash River, at Lawrence Station. The latter deposit is not exposed well enough to permit a good appraisal of the material present within its boundaries.

Mechanical Analysis: D.O.T. (1974)

sieve		2"	1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a	98		72	47	27	19		9			1.5
	b	81		58	47	39	29		6			1.4
	c	86		67	54	43	30		4			0.9

Lithologic Analysis: N.A.

Unsound Lithotypes %	Sound Lithotypes %

Estimation of Reserves:

	total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
"A"	95	15	3	450,000
"B"	26	6	2.5	150,000

Location #:	G6-12	**County:**	Charlotte
Type of Deposit:	Outwash	**Parish:**	Dumbarton
Exposure Type:	Pits	**NTS:**	21 G/6
Status:	Inactive	**UTM:**	501 212

Section Description & Comments:

At time of visit, pits were inactive and except where steep, section faces were all slumped. The maximum section height was 9 m.

The material consists of moderately sorted, stratified sand and gravel. Significant vertical textural variation is exhibited. Some clast supported pebble gravel beds and sandy cobbly pebble gravel horizons alternate with pebbly sand and sand. The sand to gravel ratio approximates 1:1. Overburden thickness averages 1.0 m and consists of oxidized sandy loam. About 10% of the clasts show manganese stains. A paleocurrent direction of 170° was obtained from trough-bedded sand and gravel. Bedrock is exposed along the Digdeguash River, below the pit.

Mechanical Analysis:

sieve		1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a		100.0	97.0	90.6	82.7	76.6	64.5	51.4	27.9	13.7
	b	84.2	74.1	53.0	34.6	21.6	14.2	6.1	3.4	2.0	1.4
	c										

Lithologic Analysis:

Unsound Lithotypes % 47	Sound Lithotypes % 53
Sandstone 29; Slate 9; Weathered 5; Siltstone 2; Mafic volcanic 1; Felsic intrusive 1	Sandstone 16; Greywacke 12; Argillite 9; Quartzite 6; Metasediment 4; Felsic intrusive 3; Quartz 3

Estimation of Reserves:

total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
175	15	4.5	700,000

Location #:	G6-13	**County:**	Charlotte
Type of Deposit:	Outwash	**Parish:**	Dumbarton
Exposure Type:	Pit	**NTS:**	21 G/6
Status:	Inactive	**UTM:**	504 206

Section Description & Comments:

Main face

0.5 m Overburden: Oxidized sand and pebble gravel; root zone.

1.5 m Sand and Gravel: Horizontally stratified and poorly sorted sand and pebble gravel with some cobbles and lenses of well sorted medium sand. Clasts are subrounded.

1.5 m Sand and Gravel: Cross-bedded and well stratified sand and sandy pebble gravel, moderately well sorted; laterally grading into a massive bed of coarse cobbly gravel with little sand matrix. Paleocurrent direction: 130°.

0.5 m Sand: Trough cross-bedded sand, medium grained and well sorted. Paleocurrent direction: 170°.

2.0 m Sand: Well sorted, cross-bedded medium sand with occasional small pebbles. Paleocurrent direction: 140°.

2.0 m Slump Covered: Assumed to be sand and gravel.

A lower lift exposes about 3 m of sand with little gravel. Clasts are in general subrounded and some show manganese stains. Flat pebbles are common. The

Mechanical Analysis:

sieve		1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a	98.2	97.7	93.8	88.6	82.9	68.0	39.6	9.4	2.6	1.2
	b	95.2	88.8	67.9	47.8	29.8	18.9	8.1	2.6	0.9	0.5
	c										

Lithologic Analysis:

Unsound Lithotypes % 49	Sound Lithotypes % 51
Sandstone 19; Slate 18; Metasediment 5; Weathered 4; Felsic intrusive 1; Chert 1; Siltstone 1	Metasediment 21; Sandstone 9; Greywacke 6; Quartz 4; Argillite 4; Felsic intrusive 3; Mafic volcanic 2; Quartzite 2

Estimation of Reserves:

total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
			SEE G6-12

Location #: G6-13 (cont'd)

silt content is low. No boulders observed in section; largest clast diameter observed was 30 cm. Signs of some very minor activity in the pit was noted.

D.O.T. (1971) testing in the area gave the following results: Los Angeles Abrasion loss: range 27.5% to 31.2%
Fine content (less than 75 µm): range, 0.9% to 42.4%; mean, 2.3%

Although parts of the deposit may contain large proportions of silt, in general, the amount of fines in a sample is less than 3%. Parts of the deposit show an excess of sand. This affects the compactibility of the pit-run aggregate.

The material has been recommended for borrow, subbase and base course aggregate. Textural variations within the deposit may require selective test-pitting to localize suitable extraction sites.

Location #:	G6-14	**County:**	Charlotte
Type of Deposit:	Outwash	**Parish:**	Dumbarton
Exposure Type:	Pit	**NTS:**	21 G/6
Status:	Active on demand	**UTM:**	507 202

Section Description & Comments:

1.0 m Overburden: Oxidized sand with some silt and small pebbles. Progressively less oxidized at depth.

4.0 m Sand: Grey, unoxidized, loose, well stratified and well sorted medium sand (sample A). Beds dip southward.

2.0 m Gravel: Well bedded pebble gravel with some cobbles and some gravel; commonly clast-supported. About 75% gravel, 25% sand, moderately sorted and with some silt. Sample B was obtained from this unit.

4.0 m Slump Covered: Assumed to be sand and gravel.

The material exhibits significant lateral and vertical variation. Laterally and eastward, it becomes very coarse and includes some cobble gravel beds with gravel to sand ratio of 80:20. Some clasts in section measure up to 50 cm in diameter. Calcium carbonate cemented sandstones have been noted; some pebbles are also coated with $CaCO_3$.

Mechanical Analysis:

sieve		1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a			100.0	99.6	99.2	98.7	80.0	28.9	5.0	1.7
	b wet sieve	90.3	85.7	71.4	54.5	33.0	15.3	6.2	4.6	3.6	3.1
	c										

Lithologic Analysis:

Unsound Lithotypes % 38	Sound Lithotypes % 62
Slate 20; Sandstone 14; Weathered 4	Sandstone 31; Argillite 15; Metasediment 6; Quartzite 5; Quartz 4; Felsic intrusive 1

Estimation of Reserves:

total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
			SEE G6-12

Location #:	G6-15	**County:**	Charlotte
Type of Deposit:	Esker	**Parish:**	Dumbarton
Exposure Type:	Pit	**NTS:**	21 G/6
Status:	Active on demand	**UTM:**	514 193

Section Description & Comments:

Material is diverse and both vertical and horizontal textural characteristics are very variable. Samples A and B represent the average grade but a significant portion of the deposit consists of coarser grade material.

The principal face measured about 9 m high. A 1 m to 2 m unit of coarse pebble and cobble gravel caps the deposit. This is underlain by stratified and moderately sorted sand and pebble gravel, that change laterally into pebble gravel and cobbly sandy pebble gravel. The maximum clast size observed in section measured 40 cm in diameter. A zone of massive sand containing occasional cobbles or pebbles was noted. Minor iron and manganese coating affects less than 5% of the clasts.

Textural and quality characteristics of the deposit are highly unpredictable as all grades of material are exposed in the pit. Crushing could probably improve the product. In some gravelly beds, the clasts were silt-coated.

Mechanical Analysis: WET SIEVE A

sieve		1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a	81.4	73.8	48.5	31.5	18.6	11.3	5.0	2.7	2.0	1.6
	b	97.1	96.4	95.3	93.9	92.9	91.5	85.3	69.4	41.8	15.0
	c										

Lithologic Analysis:

Unsound Lithotypes % 40	Sound Lithotypes % 60
Sandstone 22; Slate 8; Weathered 6; Chert 4	Greywacke 24; Quartzite 9; Argillite 7; Metasediment 6; Quartz 6; Sandstone 5; Felsic intrusive 2; Felsic volcanic 1

Estimation of Reserves:

total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
20	4	4	160,000

Location #:	G6-16	County:	Charlotte
Type of Deposit:	Pit	Parish:	Dumbarton
Exposure Type:	Esker	NTS:	21 G/6
Status:	Active on demand	UTM:	515 193

Section Description & Comments:

The main pit face measured 7 m high and exhibited the following:
3.5 m Sand and Gravel: Well stratified and well sorted sand with some fine to medium pebble gravel. Clasts are subrounded.
3.5 m Slump Covered: Assumed to be mainly sand with some gravel.

Laterally, towards the core of the deposit, the material grades into a bed of cobble gravel and to the northeast, it is overlain by fine horizontally bedded silty sand and fine to medium well sorted sand. Sample A represents the material observed in section, although coarser units are present.

D.O.T. (1972, 1971, 1959) sampling gave the following test results:
Los Angeles Abrasion loss: range, 25.9% to 34.4%; mean, 29.8%
Percentage finer than 75 µm: range, 0.9% to 4.9%; mean, 2.3%

D.O.T. approved the material for use as borrow, pit run subbase, base course aggregate and possibly filter or blending sand. It was noted that the grading was fair except for a general excess of intermediate sand.

Mechanical Analysis:

sieve		1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a	96.2	92.3	82.1	73.4	63.8	51.7	19.3	4.0	1.2	0.7
	b										
	c										

Lithologic Analysis:

Unsound Lithotypes % 36	Sound Lithotypes % 64
Sandstone 22; Slate 10; Siltstone 4	Sandstone 14; Metasediment 14; Quartz 8; Greywacke 8; Argillite 8; Felsic intrusive 5; Quartzite 5; Felsic volcanic 1; Mafic volcanic 1

Estimation of Reserves:

total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
			SEE G6-15

Location #: G6-17 County: Charlotte

Type of Deposit: Ice-contact/outwash Parish: Saint Patrick

Exposure Type: Pit NTS: 21 G/6

Status: Inactive UTM: 525 182

Section Description & Comments:

Large reserves are contained in this composite deposit. Pits have been opened in the esker ridge (ice-contact) but the outwash (delta) portion remain unexposed, as cultivated and wooded land. Large reserves (in excess of 2 million m^3) have been identified.

D.O.T. (1962) tested the site and obtained the following data:
Los Angeles Abrasion loss: range, 25.6% to 30.0%; mean, 27.4%
Percentage fine than 75 µm: range, 0.6% to 9.6%; mean, 1.4%

D.O.T. recommended use of the material as a source of borrow, subbase and base course aggregate, and suggested crushing to 1½" or 1" size to improve the grading. Some material was also identified as a possible source of blending sand or asphaltic concrete aggregate.

Test holes indicate that the material is variable and can include clasts up to 30 cm in diameter. The part of the deposit mapped as outwash was not sampled by D.O.T. but it should show greater textural uniformity, and may represent a more favourable extraction site.

Mechanical Analysis: D.O.T. (1962)

sieve		2"	1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a	61.1		55.8		38.5			21.6			2.0
	b	75.4		65.8		61.0			21.0			1.3
	c	100.0		85.7		82.4			73.2			9.6

Lithologic Analysis: N.A.

Unsound Lithotypes %	Sound Lithotypes %

Estimation of Reserves:

total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
95	40	5	2 million

Location #:	G6-18	County:	Charlotte
Type of Deposit:	Ice-contact	Parish:	Saint Patrick
Exposure Type:	Pit	NTS:	21 G/6
Status:	Inactive	UTM:	548 144

Section Description & Comments:

Several small pits have been opened into an ice-contact system consisting principally of three large flat-topped hills, centrally located in the Digdeguash Valley, between Elmsville and McMinn. The origin of these features is still unclear but their presence appear to be related to a synchronous high marine stand and a proximal position of an ice front. The three hills all stand at about 60 m elevation (a.m.s.l.).

At G6-18, an abandoned pit exhibited heavily slumped faces, up to 10 m high. A hand excavation near the top of the section showed the material to consist of pebble gravel with some cobbles. Clasts varied from subrounded to subangular. No boulders were seen but cobble-size material was common along the talus slope.

A hole was dug on top of the same hill, 300 m northwest of G6-18. One metre of moderately compact, oxidized, dirty pebbly (cobbly) sand was encountered. Excavation

Mechanical Analysis: D.O.T. (1963, 1962)

sieve		2"	1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a	77.9		60.6		36.3			5.2			1.6
	b	91.9		65.5		36.0			9.5			3.9
	c	81.8		75.2		64.1			17.1			1.3

Lithologic Analysis: N.A.

Unsound Lithotypes %	Sound Lithotypes %

Estimation of Reserves:

total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
75	20	10	2 million

Location #: G6-18 (cont'd)

into the fresh material was not achieved. Poor sorting of the material and poor rounding of the clasts was noted. Scattered occurrences of boulders were seen along the hill slope.

D.O.T. (1963, 1962) did some test-pitting and sampling in the area. Results were as follows:

Los Angeles Abrasion loss: 21.5%, 21.7% and 28.8%

Percentage finer than 75 µm: range, 1.3% to 3.9%; mean, 2.2%

The material was recommended as a source of borrow, subbase and base course aggregate.

Field observations suggest the presence of substantial volumes of aggregate but more testing is needed to fully assess the potential of the deposit and the general textural characteristics of the material.

Location #:	G6-19	**County:**	Charlotte
Type of Deposit:	Ice-contact	**Parish:**	St. Patrick
Exposure Type:	Pit	**NTS:**	21 G/6
Status:	Active on demand	**UTM:**	561 137

Section Description & Comments:

At time of visit, D.O.T. was extracting material for secondary road improvement.

A 16 m pit face showed stratified and moderately well sorted sand and pebble gravel with some cobbles. Bedding dips away from the crest on both sides suggesting the ice-contact nature of the deposit. The texture of the material is uniform vertically and laterally. Clasts are subrounded. Some iron (or manganese) cementation affects clasts at the base of the talus slope.

Only 10% of calculated reserves are presently accessible because of the presence of a cemetery located on top of the main part of the deposit.

Mechanical Analysis:

sieve		1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a	87.5	81.4	64.8	48.6	35.5	24.7	12.0	4.9	2.1	1.1
	b										
	c										

Lithologic Analysis:

Unsound Lithotypes % 28	Sound Lithotypes % 72
Sandstone 19; Weathered 5; Slate 3; Siltstone 1	Sandstone 31; Greywacke 12; Quartzite 10; Quartz 5; Siltstone 5; Felsic volcanic 4; Mafic intrusive 3; Felsic intrusive 2

Estimation of Reserves:

total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
7	1.5	10	150,000

Location #:	G6-20	County:	Charlotte
Type of Deposit:	Ice-contact	Parish:	St. Patrick
Exposure Type:	Pit	NTS:	21 G/6
Status:	Active on demand	UTM:	569 131

Section Description & Comments:

The site is locally active on demand, but in a minor way. Pit faces are steep, all slumped and about 20 m high at maximum. The material consists of moderately sorted, sand to pebble gravel with some cobbly zones. No boulders were observed on talus or at base of pit.

Immediately off the map-area, 350 m southeast of G6-20, a large pit has been developed within the same deposit. There, the more active workings afford fresh exposures and permit a better appraisal of the textural character of the deposit.

The material is well stratified and well sorted throughout and face heights average 15 m. A few boulders were noticed (average diameter of 1 m) at the base of talus slopes and on top of deposit. In general, the texture grades from medium sand to pebble gravel. Some strata are clast supported and others have a significant sand matrix. An upper metre of sandy diamicton was noted at top of the section. The bedding is regular.

Mechanical Analysis:

sieve		1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a	97.6	93.5	81.2	66.5	48.3	34.1	12.7	4.1	1.6	0.8
	b	100.0	99.5	97.7	95.2	91.4	85.3	59.5	24.7	6.9	2.0
	c										

Lithologic Analysis:

Unsound Lithotypes % 35	Sound Lithotypes % 65
Sandstone 16; Slate 10; Weathered 4; Chert 3; Siltstone 2	Sandstone 25; Argillite 15; Quartzite 12; Metasediment 7; Quartz 4; Mafic intrusive 1; Mafic volcanic 1

Estimation of Reserves:

total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
5	1	10	100,000

Location #: G6-20 (cont'd)

This deposit is morphologically similar to the other large features previously described (G6-18) and suggests that they also consist of good aggregate.

Testing by D.O.T. (1971) gave the following:
Los Angeles Abrasion loss: 22.1%, 22.3% and 22.9%
Percentage finer than 75 μm: range, 1.5% to 4.0%; mean, 1.9%

Pit-run material was recommended for borrow, subbase and base course aggregate, and also as a potential source of winter sand and filter material.

The reserve estimate applies only to the portion of the deposit included within the boundaries of map 21 G/6. Most of the deposit actually lies beyond these boundaries where an additional volume of 500,000 m^3 of granular aggregate may be found.

Location #:	G6-21	County:	Charlotte
Type of Deposit:	Glaciofluvial	Parish:	Saint Croix
Exposure Type:	Pit	NTS:	21 G/6
Status:	Inactive	UTM:	456 134

Section Description & Comments:

A small pit has been opened in a shallow and limited deposit. A 2 m section showed fine to medium well sorted sand overlying a striated bedrock surface. The percentage of coarse material was low. Bedrock outcrops were frequently encountered along the road leading to the pit, as well as beyond, towards the Waweig River. The deposit is of marginal importance only and recoverable reserves are minimal.

Test-pitting by D.O.T. (1962) demonstrated the limited extent of the aggregate deposits within the general area. Testing on one sample gave a Los Angeles Abrasion loss value of 23.8%; the fine material content in the samples ranged from 1.9% to 6.3% with a mean of 2.5%. Some of the aggregate was recommended for borrow, subbase and filter material.

Mechanical Analysis: N.A.

sieve		1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a										
	b										
	c										

Lithologic Analysis: N.A.

Unsound Lithotypes %	Sound Lithotypes %

Estimation of Reserves:

total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
			Minimal

Location #:	G6-22	County:	Charlotte
Type of Deposit:	Ablation till	Parish:	St. David
Exposure Type:	Pit	NTS:	21 G/6
Status:	Active on demand	UTM:	369 177

Section Description & Comments:

The material is poorly sorted and textures, although generally coarse, vary from moderately sorted sand at the top to poorly sorted, coarse, silty gravel and sand. Clasts are subangular. Some large boulders were noted.

The deposit was not sampled because of the coarseness of the material. Bedrock (slate) outcrops in pit. The deposit is worked intermittently as a local source of fill.

Mechanical Analysis: N.A.

sieve		1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a										
	b										
	c										

Lithologic Analysis: N.A.

Unsound Lithotypes %	Sound Lithotypes %

Estimation of Reserves:

total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
			Minimal

Location #:	G6-23	County:	Charlotte
Type of Deposit:	Outwash	Parish:	St. James
Exposure Type:	Pit	NTS:	21 G/6
Status:	Active on demand	UTM:	317 148

Section Description & Comments:

Northwest face

0.4 m Overburden: Silty, oxidized, sand and gravel.

0.8 m Gravel and Sand: Poorly stratified, moderately sorted, pebble gravel with a minor sand matrix; some cobbles. Clasts are subrounded to rounded.

2.5 m Sand and Gravel: Well stratified, loose and moderately well sorted, sand and fine to medium pebble gravel with occasional large pebbles and small cobbles; low proportion of silt; sample A was obtained from this unit. Paleocurrent direction of 150°.

In general, pit faces are badly slumped and only the northwest part of the pit showed any sign of recent activity. The material is fine and generally in the pebble gravel size range with a gravel to sand ratio of about 1:1.

Reserve calculations incorporate the full extent of the outwash body between Faheys Hill and Kates Hill along the Basswood Ridge Road. A hammer-seismic survey suggests that thicknesses of up to 7 m can be expected within the area. Test-pitting should be done to further evaluate the aggregate potential of the deposit.

Mechanical Analysis:

sieve		1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a	93.4	88.6	75.0	60.4	41.6	25.4	5.5	1.9	1.3	0.9
	b										
	c										

Lithologic Analysis:

Unsound Lithotypes % 33	Sound Lithotypes % 67
Sandstone 16; Weathered 6; Metasediment 6; Slate 5	Sandstone 24; Metasediment 14; Quartzite 11; Mafic volcanic 5; Felsic intrusive 4; Felsic volcanic 4; Quartz 2; Argillite 2; Mafic intrusive 1

Estimation of Reserves:

total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
400	60	3	2 million

Location #: G6-24 **County:** Charlotte

Type of Deposit: Esker and Outwash **Parish:** St. James

Exposure Type: Pits **NTS:** 21 G/6

Status: Active on demand **UTM:** 306 166

Section Description & Comments:

Esker face

0.5 m Overburden: Oxidized sand loam.

1.0 m Sand: Well stratified and well sorted fine to medium sand with some fine pebble gravel.

2.0 m Sand and Gravel: Moderately sorted and stratified sand and pebble gravel. Lateral slumping of the beds.

3.0 m Slump Covered: Assumed to be sand and gravel.

The texture is uniform but tends to be coarser in the core of the ridge. Clasts are subrounded and some manganese-coated pebbles were noted. Only a few boulders occur (40 cm in maximum diameter).

Outwash face

0.6 m Sand: Moderately well sorted fine to medium sand, oxidized at the top (soil horizon).

0.8 m Gravel and Sand: Crudely stratified, clast-supported, cobbly pebble gravel and pebbly sand to sandy pebble gravel. Clasts are generally subrounded.

Mechanical Analysis:

sieve		1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a		100.0	99.9	99.5	99.0	98.4	91.5	34.7	3.7	1.0
	b	81.8	75.7	58.7	48.5	38.8	30.5	9.8	3.8	2.2	1.3
	c										

Lithologic Analysis:

Unsound Lithotypes % 38	Sound Lithotypes % 62
Sandstone 22; Weathered 7; Slate 5; Shale 3; Chert 1	Sandstone 27; Quartzite 13; Metasediment 10; Felsic intrusive 4; Felsic volcanic 3; Quartz 3; Mafic volcanic 1; Argillite 1

Estimation of Reserves:

total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
35	7	5	300,000

Location #: G6-24 (cont'd)

2.0 m Slump Covered: Assumed to be gravel and sand.

The outwash flanks the eskers ridge, adopting an undulating to hummocky landscape (pitted outwash?).

D.O.T. (1966) tested 44 samples in the area. Results were as follows:
Los Angeles Abrasion loss: range, 22.9% to 27.7%; mean, 25.0%
Percentage finer than 75 μm: range, 1.1% to 3.8%; mean, 2.1%

Proposed use of the material was for crushing.

Location #:	G6-25	County:	Charlotte
Type of Deposit:	Esker	Parish:	St. James
Exposure Type:	Pit	NTS:	21 G/6
Status:	Active on demand	UTM:	300 173

Section Description & Comments:

The deposit exhibits significant vertical and horizontal textural variation. Stratification is well displayed and the typical esker cross-section can be seen with bedding getting progressively more slumped and faulted towards the flanks of the ridge. Paleocurrent directions indicate a southeastward flow. The main face measured 21 m high.

Section:
2.5 m Gravel and Sand: Poorly sorted and poorly stratified pebble gravel with cobbles set in a sand matrix. Clasts are subrounded. Material is oxidized near the top of the section.
4.0 m Sand and Gravel: Well-sorted and stratified sand and pebbly sand. Clasts are pebble-size and the material is finer than the above unit.
4.5 m Slump Covered: Assumed to be sand and gravel.

The maximum clast size diameter observed along the talus slope measured 30 cm.

Crushing (½") and sieving operations have taken place on the site as demonstrated by stockpiles; 25% to 30% of the clasts contained some $CaCO_3$ as matrix cement or outer coating.

Mechanical Analysis:

sieve		1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a				100.0	99.4	95.8	36.9	5.1	2.0	1.0
	b	95.4	91.9	79.0	68.8	60.3	50.9	28.3	4.1	1.2	0.7
	c										

Lithologic Analysis:

Unsound Lithotypes % 26	Sound Lithotypes % 74
Sandstone 16; Slate 6; Weathered 2; Calcite 1; Chert 1	Sandstone 42; Quartzite 15; Metasediment 7; Argillite 5; Mafic intrusive 1; Felsic intrusive 1; Felsic volcanic 1; Quartz 1; Conglomerate 1

Estimation of Reserves:

total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
			SEE G6-24

Location #:	G6-26	County:	Charlotte
Type of Deposit:	Ice-contact	Parish:	St. James
Exposure Type:	Pit	NTS:	21 G/6
Status:	Active on demand	UTM:	272 220

Section Description & Comments:

The flanks of the deposit consist of sandy material but coarse, well sorted pebble gravel occur at the core. The texture is relatively uniform. The deposit exhibits a hummocky surface with depressions that are commonly partly filled with fine silty dense sand or ablation till. Granite pebbles occur commonly and a minor percentage (about 5%) of the clasts are coated with manganese.

Calculated reserves include the entire ice-contact system that extend from G6-26 to the mouth of the Canoose River.

Mechanical Analysis:

sieve		1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a	90.9	86.8	72.6	60.3	46.0	28.9	8.5	3.7	2.2	1.4
	b		100.0	99.7	99.1	95.1	74.0	17.2	3.2	2.0	1.2
	c										

Lithologic Analysis:

Unsound Lithotypes % 31	Sound Lithotypes % 69
Sandstone 16; Weathered 8; Slate 4; Chert 3	Sandstone 23; Felsic intrusive 14; Metasediment 13; Quartzite 9; Argillite 6; Felsic volcanic 3; Quartz 1

Estimation of Reserves:

total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
105	20	5	1 million

Location #:	G6-27	County:	Charlotte
Type of Deposit:	Esker	Parish:	St. James
Exposure Type:	Pits	NTS:	21 G/6
Status:	Active on demand	UTM:	261 227

Section Description & Comments:

The eastern pit exhibits badly slumped faces that are partially vegetated. Only minor activity had taken place in recent times. Few large clasts were observed and well sorted sand (sample A) dominated the sections; some gravel beds have been noted. Where sample A was obtained, the pit face measured 6 m high. Clasts are subrounded; the overburden thickness averages 0.5 m.

The western pit exhibits two lifts:

Top lift

0.5 m Overburden: Oxidized sand and pebble gravel.

2.0 m Gravel and Sand: Well stratified sandy pebble gravel with some beds of cobble gravel. Clasts are subrounded to rounded and the maximum clast size observed was 25 cm in diameter. Texture is variable laterally and vertically.

2.5 m Slump Covered: Assumed to be sand and gravel.

Lower lift

About 4 m of well stratified and moderately well sorted sand and fine to medium pebble gravel (sample B). Horizontal undeformed stratification. Low proportion of silt.

Mechanical Analysis:

sieve		1"	3/4"	3/8"	#4	8	14	30	50	100	200
% passing	a						100.0	99.3	68.0	11.3	2.2
	b	91.0	86.4	69.5	56.4	38.9	19.7	4.8	2.4	1.5	1.1
	c										

Lithologic Analysis:

Unsound Lithotypes % 20	Sound Lithotypes % 80
Sandstone 12; Weathered 4; Conglomerate 2; Slate 2	Sandstone 24; Metasediment 17; Quartzite 11; Felsic intrusive 10; Argillite 5; Mafic volcanic 4; Felsic volcanic 3; Quartz 3; Mafic intrusive 2; Conglomerate 1

Estimation of Reserves:

total deposit area (hectares)	area workable (hectares)	average thickness (meters)	recoverable reserves (m^3) probable
			SEE G6-26

LOCATION #: G6-27 (cont'd)

Large volumes of material have been obtained from the deposit but little activity was evident during period of study (1981). Substantial reserves remain.

D.O.T. (1973) testing gave the following results:

Los Angeles Abrasion loss: average of 24.6%

Percentage finer than 75 µm: range, 2.1% to 3.6%; mean, 2.8%

Recommended for: borrow, subbase, base course (1½" crushed) aggregate.

APPENDIX C

SAMPLE DESCRIPTIONS

OF

SAINT STEPHEN MAP AREA

21 G/3

LOCATION #: G3-1 NTS: 21 G/3

Type of Deposit: Ice-contact County: Charlotte

Exposure Type: Pit Parish: St. James

Status: Inactive UTM: 242 112

SECTION DESCRIPTION & COMMENTS:

0.3 m Overburden: Soil horizon; silty pebbly sand loam.

1.7 m Sand and Gravel: Stratified, moderately sorted, fine to medium pebble gravel and sand, with some silt. Clasts are subangular to subrounded with maximum size observed of 10 cm.

1.0 m Silt and Sand: Bedded silt and silty sand.

0.5 m Sand: Well sorted medium sand.

2.0 m Slump Covered: Assumed to be mainly sand with some pebble gravel.

Some boulders occurred along the talus slopes and on the pit floor. About 10% of the clasts show manganese stains. In general, the material is fine and usage is restricted to borrow or sub-grade.

MECHANICAL ANALYSIS:

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.4mm	600µm	300µm	150µm	75µm
% passing	a	91.1	86.1	61.8	37.2	21.0	14.1	7.1	3.3	1.9	1.0
	b						100.0	98.8	76.4	21.2	5.9
	c										

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 43%

Sandstone 32; Weathered 4; Chert 3; Slate 3; Metasediment 1

Sound Lithotypes 57%

Sandstone 32; Quartzite 10; Mafic volcanic 4; Metasediment 4; Quartz 3; Mafic intrusive 2; Felsic intrusive 1; Argillite 1

ESTIMATION OF RESERVES:

total deposit area (hectares)	area workable (hectares)	average thickness (metres)	recoverable reserves (m^3) probable
			minimal

LOCATION #: G3-2 NTS: 21 G/3

Type of Deposit: Ice-contact County: Charlotte

Exposure Type: Pit Parish: St. James

Status: Inactive UTM: 243 106

SECTION DESCRIPTION & COMMENTS:

0.3 m Overburden: Soil horizon.

3.0 m Sand and Gravel: Well bedded and well sorted medium to fine pebble gravel with little matrix, and well sorted medium sand.

3.5 m Slump Covered: Assumed to be sand and gravel.

The textural variation within the pit is moderate and the material generally consists of sand and fine gravel. Several large boulders were noted (maximum diameter of 1.5 m).

MECHANICAL ANALYSIS:

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.4mm	600µm	300µm	150µm	75µm
% passing	a	99.5	97.0	89.4	71.2	39.0	17.1	5.4	2.6	1.5	0.9
	b										
	c										

LITHOLOGIC ANALYSIS: N.A.

Unsound Lithotypes	%	Sound Lithotypes	%

ESTIMATION OF RESERVES:

total deposit area (hectares)	area workable (hectares)	average thickness (metres)	recoverable reserves (m^3) probable
16	3	4	120,000

LOCATION #:	G3-3	NTS:	21 G/3
Type of Deposit:	Esker	County:	Charlotte
Exposure Type:	Pits	Parish:	St. James
Status:	Inactive	UTM:	269 064

SECTION DESCRIPTION & COMMENTS:

At time of visit the pits were inactive. Slumped faces measured up to 6 m high. The deposit is part of an esker that extends discontinuously along the Mohannes valley from Upper Little Ridge to Upper Mills. North of Lower Little Ridge, the esker is very subdued and difficult to map. The likelihood of intercepting an ice-contact ridge between G3-3 and G3-2 along the 60 m topographic contour line is good but no large volumes of material are predicted.

D.O.T. (1973) examined the deposit and noted that the material was erratically graded and that tonnage was limited. The Los Angeles abrasion loss was 24.5%. Recommended use was for borrow and subbase.

Moraines have been identified east of G3-3 on both sides of Mohannes stream but field checks have shown no sign of sand or gravel. The terrain is bouldery and till was encountered in hand excavations.

MECHANICAL ANALYSIS: D.O.T. (1973)

sieve		38mm	25mm	19mm	9.5mm	4.75mm	2.36mm	1.4mm	600µm	300µm	150µm	75µm
% passing	a			100	98	94	87		72			6.7
	b	97		87	76	65	53		22			4.0
	c		100	91	75	56	40		13			1.7

LITHOLOGIC ANALYSIS: N.A.

Unsound Lithotypes	%	Sound Lithotypes	%

ESTIMATION OF RESERVES:

total deposit area (hectares)	area workable (hectares)	average thickness (metres)	recoverable reserves (m^3) probable
25	3	3	90,000

LOCATION #: G3-4 NTS: 21 G/3

Type of Deposit: Esker County: Charlotte

Exposure Type: Pit Parish: St. Stephen

Status: Inactive UTM: 275 049

SECTION DESCRIPTION & COMMENTS:

0.3 m Overburden: Soil horizon.

2.2 m Sand and Gravel: Poorly exposed because of slumping. Coarse pebble gravel and sand, probably stratified. The material is loose and moderately sorted; increasing silt content and greater degree of compaction towards the base. The maximum clast diameter observed was 20 cm.

2.0 m Silt: Dense, compact, light olive brown clayey silt, with some small pebbles ranging in size to 4 cm. Not apparently laminated but fossiliferous (marine).

2.0 m Slump Covered: Assumed to be mainly sand and gravel.

The pit is inactive, largely abandoned and partially vegetated. Significant lateral and vertical textural variation can be expected.

Old pit workings were inspected, 100 m west of G3-4 along the esker crest. Excavations revealed sand on the crest and gravel along the flanks of the ridge. The deposit is part of the Mohannes esker system. The aggregate potential is good but textural variability is to be expected.

MECHANICAL ANALYSIS: N. A

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.4mm	600µm	300µm	150µm	75µm
% passing											

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 37%	Sound Lithotypes 63 %
Sandstone 21; Weathered 9; Schist 5; Chert 2	Sandstone 28; Quartzite 14; Metasediment 10; Quartz 5; Siltstone 4; Mafic intrusive 1; Felsic intrusive 1

ESTIMATION OF RESERVES:

total deposit area (hectares)	area workable (hectares)	average thickness (metres)	recoverable reserves (m^3) probable
			SEE G3-3

LOCATION #: G3-5 NTS: 21 G/3

Type of Deposit: Ice-contact County: Charlotte

Exposure Type: Pit Parish: St. Stephen

Status: Inactive UTM: 284 042

SECTION DESCRIPTION & COMMENTS:

Southeast face

0.6 m Overburden: Fissile silt and silty sand with a few small pebbles.

0.4 m Sand: Loose, moderately well sorted coarse sand.

5.0 m Slump Covered: Assumed to be sand and gravel.

The character of the material varies (large boulders were noted) but is generally fine-textured.

MECHANICAL ANALYSIS:

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.4mm	600µm	300µm	150µm	75µm
% passing	a	98.8	97.5	93.2	88.1	84.0	81.5	76.5	55.4	23.6	7.6
	b										
	c										

LITHOLOGIC ANALYSIS: N.A.

Unsound Lithotypes	%	Sound Lithotypes	%

ESTIMATION OF RESERVES:

total deposit area (hectares)	area workable (hectares)	average thickness (metres)	recoverable reserves (m^3) probable
			SEE G3-6

LOCATION #:	G3-6	NTS:	21 G/3
Type of Deposit:	Ice-contact	County:	Charlotte
Exposure Type:	Pits	Parish:	St. Stephen
Status:	Active on demand	UTM:	287 040

SECTION DESCRIPTION & COMMENTS:

Principal section

1.0 m Overburden: Soil horizon.

5.0 m Sand and Gravel: Well bedded and moderately sorted medium to coarse sand with pebbles and some cobbles; beds of coarse cobbly pebble gravel and cobble gravel are clast supported. Bed thicknesses and texture are variable, both laterally and vertically.

4.0 m Slump Covered: Assumed to be sand and gravel.

Minor clast cementation noticed; pebbles are generally subrounded to rounded.

Lower lift

2.0 m Sand: Fine to medium, well sorted and well bedded sand.

1.0 m Sand and Gravel: Well stratified but only moderately sorted sand and medium pebble gravel with occasional coarse pebbles or cobbles.

1.0 m Gravel: Very coarse bed of clast supported pebbly cobble gravel with some small boulders (0.5 m diameter).

2.0 m Slump Covered: Assumed to be sand and gravel.

MECHANICAL ANALYSIS:

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.4mm	600µm	300µm	150µm	75µm
% passing	a	97.3	96.1	93.0	88.2	79.7	70.2	38.3	15.9	5.0	1.3
	b			100.0	99.6	93.9	81.5	46.1	9.0	2.2	1.1
	c										

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 47%	Sound Lithotypes 53%
Sandstone 36; Weathered 5; Chert 3; Metasediment 2; Slate 1	Sandstone 28; Quartzite 7; Quartz 5; Siltstone 5; Metasediment 5; Mafic volcanic 2; Felsic volcanic 1

ESTIMATION OF RESERVES:

total deposit area (hectares)	area workable (hectares)	average thickness (metres)	recoverable reserves (m^3) probable
62	12	5	600,000

LOCATION #: G3-6 (cont'd)

Lower lateral face

The section displays an unconformable lateral contact between stiff, dense, blocky brown clayey silt and slumped beds of sand and gravel. The bedding is confused at the contact.

The deposit shows extremes in textural character; the material is however generally sandy with some selective areas where coarse sand and gravel predominate.

In another pit, southwest of the road and adjacent to G3-6, fine-textured material is again displayed. Poor drainage in some parts of that pit may indicate the presence of silty horizons. Laminated silts overlie in places the ice-contact sands and gravels.

LOCATION #:	G3-7	NTS:	21 G/3
Type of Deposit:	Ice-contact	County:	Charlotte
Exposure Type:	Pits	Parish:	St. Stephen
Status:	Active on demand	UTM:	292 033

SECTION DESCRIPTION & COMMENTS:

Main section

2.0 m Sand Well stratified and well sorted medium sand.

1.0 m Sand and Gravel: Poorly sorted and poorly bedded sand and coarse cobbly pebble gravel.

3.0 m Slump Covered: Assumed to be sand and gravel.

Back section

4.0 m Silt: Dense brown blocky silt, finely laminated with occasional drop-stones.

2.0 m Sand: Finely bedded sand with some small pebbles, interstratified with beds of fine sandy pebble gravel.

The major characteristic of the pit is variability. All grades of material are to be found and much lateral and vertical variation to be expected. A 2 to 3 m capping of silt is common over the sandy gravel. Clasts are generally subrounded to rounded; slump-bedding in places.

MECHANICAL ANALYSIS: N.A.

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.4mm	600µm	300µm	150µm	75µm
% passing											

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 30 %	Sound Lithotypes 70 %
Sandstone 24; Siltstone 4; Weathered 2	Sandstone 32; Siltstone 9; Quartzite 7; Mafic volcanic 5; Quartz 5; Mafic intrusive 4; Felsic intrusive 4; Felsic volcanic 4

ESTIMATION OF RESERVES:

total deposit area (hectares)	area workable (hectares)	average thickness (metres)	recoverable reserves (m^3) probable
			SEE G3-6

LOCATION #: G3-8 NTS: 21 G/3

Type of Deposit: Bedrock County: Charlotte

Exposure Type: Quarry Parish: St. Stephen

Status: Inactive UTM: 270 015

SECTION DESCRIPTION & COMMENTS:

The material quarried consist of massive and deeply fractured banded grey quartzose sandstone and argillite; the grain texture is fine to medium and micaceous; the rock is slightly metamorphosed.

The main face measures 16.5 m high and is topped by less than 1 m of till. The material was probably used in conjunction with the building of a dam across the Ste-Croix River at Woodland.

MECHANICAL ANALYSIS: N.A.

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.4mm	600µm	300µm	150µm	75µm
% passing											

LITHOLOGIC ANALYSIS: N.A.

Unsound Lithotypes	%	Sound Lithotypes	%

ESTIMATION OF RESERVES:

total deposit area (hectares)	area workable (hectares)	average thickness (metres)	recoverable reserves (m^3) probable
			Substantial

LOCATION #: G3-9 NTS: 21 G/3

Type of Deposit: Esker County: Charlotte

Exposure Type: Pit Parish: St. Stephen

Status: Active on demand UTM: 300 014

SECTION DESCRIPTION & COMMENTS:

West section

The total height of the main face is 11 m but only the top three metres were well exposed. The material is dominantly sandy but coarser than in the south section. It consists of moderately well sorted coarse sand with some pebbles and occasional cobbles; clasts measure up to 20 cm in diameter and are generally rounded to well rounded. About 25% of the clasts exhibit manganese stains. Paleocurrent direction indicated southerly flow.

South section

1.0 m Overburden: Blocky light brown sandy silt with some very small pebbles.

2.0 m Sand: Well bedded and moderately well sorted, coarse to fine sand with some silty sand beds. No large clasts in section. Sample A was obtained from this horizon.

9.0 m Slump Covered: Assumed to be mainly sand.

MECHANICAL ANALYSIS:

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.4mm	600µm	300µm	150µm	75µm
% passing	a			100.0	98.9	96.4	92.7	83.1	53.9	20.3	7.2
	b	91.5	88.6	83.5	75.1	62.2	44.7	9.9	2.8	1.6	1.1
	c										

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 46%	Sound Lithotypes 54%
Sandstone 35; Weathered 6; Slate 4; Schist 1	Sandstone 33; Quartzite 8; Felsic intrusive 7; Quartz 3; Mafic intrusive 1; Mafic volcanic 1; Felsic volcanic 1

ESTIMATION OF RESERVES:

total deposit area (hectares)	area workable (hectares)	average thickness (metres)	recoverable reserves (m^3) probable
66	18	5	900,000

LOCATION #: G3-10 NTS: 21 G/3

Type of Deposit: Esker County: Charlotte

Exposure Type: Pit Parish: St. Stephen

Status: Inactive UTM: 311 998

SECTION DESCRIPTION & COMMENTS:

The maximum section height observed in pit was 7.5 m. Faces were badly slumped and partially vegetated. The material consists principally of moderately well sorted medium grain sand. The northeast portion of the pit is more gravelly (sandy pebble gravel) and one 2 m diameter boulder was noticed along the talus slope. About 15% of the pebbles show some manganese coating. Some loose, well sorted pea-size gravel occurring at the top of the section may indicate beach development.

The deposit extends southeasterly into the village of Upper Mills where potential reserves are estimated at 200,000 m^3. Brown silt commonly drapes the land surface to depths of at least 1 m.

MECHANICAL ANALYSIS:

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.4mm	600µm	300µm	150µm	75µm
% passing	a	94.1	94.0	91.4	85.1	75.1	58.6	22.6	6.0	3.1	1.8
	b	90.1	84.4	60.8	36.8	21.0	13.2	10.9	9.5	4.6	1.4
	c										

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 42%	Sound Lithotypes 58%
Sandstone 30; Schist 5; Slate 4; Weathered 2; Chert 1	Sandstone 23; Metasediment 9; Quartzite 7; Felsic intrusive 5; Argillite 5; Quartz 4; Mafic volcanic 3; Mafic intrusive 1; Felsic volcanic 1

ESTIMATION OF RESERVES:

total deposit area (hectares)	area workable (hectares)	average thickness (metres)	recoverable reserves (m^3) probable
6	5	10	500,000

LOCATION #:	G3-11	NTS:	21 G/3
Type of Deposit:	Marine/Ice-contact	County:	Charlotte
Exposure Type:	Pits	Parish:	St. Stephen
Status:	Abandoned	UTM:	306 051

SECTION DESCRIPTION & COMMENTS:

The deposit consists of a weakly expressed ice-contact ridge (esker). At the time of visit, the pits were abandoned, largely overgrown and all faces were slumped. The texture of the material varies from boulders (1 m in diameter) to fine sand. Face heights averaged 3 to 4 m. The deposit appears shallow. About 300 m west of G3-11, 0.5 m of moderately loose sand and gravel was encountered in a hand-shovel excavation at the top of a small hill knob. Digging was difficult because of the cobbly nature of the material.

Approximately 1 km southeast of G3-11, a small pit exhibited some gravel and sand below a dense, stiff, mottled brown and dark-streaked clayey silt horizon. Large boulders (and possibly bedrock) were also noted.

The entire deposit is interpreted as a marine-reworked esker, in places blanketed by silt and clay. The relief is very subdued and not easily observable. The deposit is discontinuous, shallow and offers limited potential.

MECHANICAL ANALYSIS: N.A.

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.4mm	600µm	300µm	150µm	75µm
% passing											

LITHOLOGIC ANALYSIS: N.A.

Unsound Lithotypes	%	Sound Lithotypes	%

ESTIMATION OF RESERVES:

total deposit area (hectares)	area workable (hectares)	average thickness (metres)	recoverable reserves (m^3) probable
			Limited

LOCATION #: G3-12 NTS: 21 G/3

Type of Deposit: Outwash County: Charlotte

Exposure Type: Pits Parish: St. Stephen

Status: Active on demand UTM: 358 116

SECTION DESCRIPTION & COMMENTS:

West face

1.0 m Gravel and Sand: Horizontally bedded sandy pebble gravel.

1.5 m Sand and Gravel: Coarse sandy pebble gravel and moderate to well sorted sand. Clasts are rounded. Paleocurrent direction to the south.

5.0 m Slump Covered: Assumed to be sand and gravel.

North face

0.5 m Overburden: Oxidized soil horizon.

0.5 m Gravel: Pebble gravel.

1.5 m Sand: Well sorted medium sand.

2.5 m Gravel and Sand: Fine to medium pebble gravel and sand.

Sections average 5 m high and clean faces in the main pit area indicate recent activity. One front-end loader was seen on site but it was inactive at time of visit. The material is texturally uniform, regularly bedded and well sorted. Only one boulder was observed (1.5 m diameter) within the pit area.

MECHANICAL ANALYSIS:

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.4mm	600µm	300µm	150µm	75µm
% passing	a	88.2	83.0	66.0	50.3	33.8	19.8	5.1	2.6	1.5	1.1
	b										
	c										

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 43 %

Sandstone 32; Weathered 7; Chert 2; Schist 2

Sound Lithotypes 57%

Sandstone 31; Metasediment 10; Quartzite 9; Quartz 5; Felsic intrusive 1; Felsic volcanic 1

ESTIMATION OF RESERVES:

total deposit area (hectares)	area workable (hectares)	average thickness (metres)	recoverable reserves (m^3) probable
60	10	5	500,000

LOCATION #: G3-12 (cont'd)

Some parts of the pit have up to 80% gravel. The deposit offers good potential for crushed aggregate.

D.O.T. (1959, 1972) examined the deposit and obtained the following laboratory results:

Percentage finer than 75μm: range 1.4% to 5.7%; mean, 2.0%

Los Angeles abrasion loss: range 25.0% to 34.1%; mean, 27,6%

D.O.T. remarked that the material possessed a fairly regular grading with a top particle size of 7.5 to 10 cm. An excess of #8 to #30 mesh sand was noted (2.36 mm to 600μm). Crushing to 3 cm size was suggested to improve the grading, thus the compacting qualities and workability of the material. Recommended use was for borrow, subbase and base course aggregate.

LOCATION #: G3-13 NTS: 21 G/3

Type of Deposit: Outwash County: Charlotte

Exposure Type: Pit Parish: St. Stephen

Status: Active on demand UTM: 362 111

SECTION DESCRIPTION & COMMENTS:

Most of the pit is now abandoned and faces are slumped. Some material is extracted on demand. The main section was 5 m high and displayed well sorted, well bedded, fine to medium sand with some small pebbles. Beds were dipping 28° in a southwesterly direction. The texture is uniform and dominantly sandy.

D.O.T. (1959) sampling in the area gave the following results:
Percentage finer than 75µm: range, 0.6% to 2.0%; mean, 1.1%
Los Angeles abrasion loss: range, 21.0% to 29.4%; mean, 23.0%

This portion of the deposit is sand dominated.

MECHANICAL ANALYSIS:

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.4mm	600µm	300µm	150µm	75µm
% passing	a				100.0	99.7	99.1	93.8	32.5	3.8	1.3
	b										
	c										

LITHOLOGIC ANALYSIS: N.A.

Unsound Lithotypes	%	Sound Lithotypes	%

ESTIMATION OF RESERVES:

total deposit area (hectares)	area workable (hectares)	average thickness (metres)	recoverable reserves (m^3) probable
			SEE G3-14

LOCATION #:	G3-14	NTS:	21 G/3
Type of Deposit:	Outwash/Ice-contact	County:	Charlotte
Exposure Type:	Pit	Parish:	St. Stephen
Status:	Active	UTM:	361 099

SECTION DESCRIPTION & COMMENTS:

Far west pit

A 9 m section exposes steeply bedded and faulted stratified beds of well sorted medium sand, sand and fine gravel, and coarse gravel. Some gravel beds lack almost any sand matrix. The silt content is low. Sample A was obtained from a sandy horizon; the overall gravel to sand ratio was estimated at 60:40. The texture of the material is very variable both vertically and laterally. The maximum clast diameter was 20 cm. Bedding slopes at 30° to the southeast.

The deposit is operated in several lifts. The top lift now extends to the power line corridor and the entire crest of the deposit has been removed since 1976. Crushing and screening operations were taking place at time of visit. Pit-run gravel was also extracted.

Top lift

Up to 1.5 m of silty sand overburden has been removed. Sections in this part of the pit are 2 to 7 m high and the exposed material is texturally variable, from cobbly gravel beds to well sorted medium sand. A paleocurrent direction of 140° was noted.

The origin of the deposit is multiple. The flat top/steep front morphology is suggestive of a delta, whereas the pitted surface and the textural variability indicate an ice-proximal environment.

MECHANICAL ANALYSIS:

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.4mm	600µm	300µm	150µm	75µm
% passing	a	100.0	98.6	89.4	80.0	69.9	59.1	36.5	9.4	2.2	0.9
	b										
	c										

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 47%	Sound Lithotypes 53%
Sandstone 34; Weathered 5; Schist 5; Siltstone 2; Mafic intrusive 1	Sandstone 19; Quartzite 13; Metasediment 11; Quartz 5; Felsic intrusive 2; Mafic intrusive 1; Mafic volcanic 1; Siltstone 1

ESTIMATION OF RESERVES:

total deposit area (hectares)	area workable (hectares)	average thickness (metres)	recoverable reserves (m^3) probable
120	45	10	4.5 million

LOCATION #:	G3-15	NTS:	21 G/3
Type of Deposit:	Marine/Ice-contact	County:	Charlotte
Exposure Type:	Pit	Parish:	St. Stephen
Status:	Inactive	UTM:	379 088

SECTION DESCRIPTION & COMMENTS:

The core of this deposit has been intensively mined. At the time of visit, the main pit was inactive and sections up to 12 m high displayed well bedded and well sorted medium to fine sand. Sample A was obtained from this face and is representative of the material found in this part of the deposit.

At the top of a steep section, grey mottled, blocky, dense silty clay was seen overlying brown sand, the contact being marked by an oxidized or manganese-rich crust. Peat occurred on top of the clay.

In the central part of the pit, beds of cobble gravel and pebble gravel were exposed within a unit of well sorted medium sand.

About 400 m northeast of G3-15, Warren Maritimes is operating an asphalt plant and crushing material obtained from the core of the deposit. Exposures display well stratified but texturally variable sand and pebble gravel with some cobbly beds.

D.O.T. (1963) testing in the area gave the following laboratory test results:
Percentage finer than 75µm: range, 1.8% to 7.6%; mean, 3.0%
Los Angeles abrasion loss: range 26.7% to 27.8%; mean, 27.0%

D.O.T. recommended the material for use as borrow, subbase, base course aggregate and soil filter.

MECHANICAL ANALYSIS:

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.4mm	600µm	300µm	150µm	75µm
% passing	a				100.0	99.4	98.6	94.2	82.9	46.9	11.5
	b										
	c										

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 39%	Sound Lithotypes 61%
Sandstone 22; Weathered 5; Schist 5; Slate 4; Siltstone 2; Chert 1	Sandstone 35; Quartzite 10; Metasediment 6; Felsic intrusive 5; Siltstone 3; Mafic volcanic 1; Quartz 1

ESTIMATION OF RESERVES:

total deposit area (hectares)	area workable (hectares)	average thickness (metres)	recoverable reserves (m^3) probable
37	5	6	300,000

LOCATION #:	G3-16	NTS:	21 G/3
Type of Deposit:	Marine/Ice-contact	County:	Charlotte
Exposure Type:	Excavations (D.O.T.)	Parish:	St. David
Status:	Undeveloped	UTM:	389 081

SECTION DESCRIPTION & COMMENTS:

Several pits have been opened in this part of the deposit. The core of the esker has been mined intensively and north of highway #1, reserves are nearing depletion.

D.O.T. (1968) tested the material on a property located between two existing pits and recorded the following:
Percentage finer than 75µm: range, 2.3% to 11.8%; mean, 4.1%
Los Angeles abrasion loss: 25.7% and 28.0%

The most objectionable feature noted was the excess of fines. The material was thus recommended for borrow and sand filter. Clay and silty clay were encountered at depths ranging from 0.3 m to 1.5 m. The clay is of marine origin and ice-contact sand and gravel are probably present at depth.

MECHANICAL ANALYSIS:

sieve		50mm	25mm	19mm	9.5mm	4.75mm	2.36mm	1.4mm	600µm	300µm	150µm	75µm
% passing	a	81.5		56.2		36.5			13.3			4.1
	b			91.4		54.4			16.2			11.8
	c	96.2		82.1		59.6			20.1			7.6

LITHOLOGIC ANALYSIS: N.A.

Unsound Lithotypes	%	Sound Lithotypes	%

ESTIMATION OF RESERVES:

total deposit area (hectares)	area workable (hectares)	average thickness (metres)	recoverable reserves (m^3) probable
			SEE G3-17

LOCATION #:	G3-17	NTS:	21 G/3
Type of Deposit:	Marine/Ice-contact	County:	Charlotte
Exposure Type:	Pit	Parish:	St. Stephen
Status:	Active on demand	UTM:	396 081

SECTION DESCRIPTION & COMMENTS:

At time of visit, no activity was taking place but crushing and screening equipment occupied the site.

The north face of the pit is 12 m high and shows a high vertical cut into uniform pebble gravel. Bedding is poorly developed. Clasts are commonly coated with silt. Large clasts are absent. Laterally, towards the northeast, this material grades into a moderately well sorted unit of sand and pebble gravel, well bedded and texturally uniform (sample A was obtained from that unit). Continuing towards the northeast, the section exhibits thick beds of grey clayey silt (olive brown where oxidized). This clay is capped by moderately sorted sand and gravel.

The east wall of the pit is poorly exposed and consists of fine material: well bedded, moderately sorted sand and pebble gravel. Some silt also occurs within the section.

The south face showed signs of recent activity and displayed well sorted medium sand with beds of coarse cobbly pebble gravel.

The deposit is characterized by an ice-contact core (esker) that has been subjected to marine reworking and deposition. Marine silt and clay fill the depressions on the uneven surface of the ice-contact body. The core of the deposit has been selectively mined as this is where the coarse aggregate is most likely to be found.

MECHANICAL ANALYSIS:

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.4mm	600µm	300µm	150µm	75µm
% passing	a	95.7	95.0	82.6	71.8	58.8	46.2	20.7	6.4	2.7	1.4
	b										
	c										

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 31%	Sound Lithotypes 69%
Sandstone 20; Chert 4; Schist 4; Siltstone 2; Weathered 1	Sandstone 23; Quartzite 18; Metasediment 11; Quartz 7; Felsic intrusive 5; Mafic volcanic 3; Mafic intrusive 1; Felsic volcanic 1

ESTIMATION OF RESERVES:

total deposit area (hectares)	area workable (hectares)	average thickness (metres)	recoverable reserves (m^3) probable
90	10	10	1 million

LOCATION #: G3-18 NTS: 21 G/3

Type of Deposit: Marine/Ice-contact County: Charlotte

Exposure Type: Pit Parish: St. Stephen

Status: Inactive UTM: 406 086

SECTION DESCRIPTION & COMMENTS:

All sections are slumped and the material is poorly exposed. The main section is 6 m high. The material displayed includes a dense pebbly silt diamicton (till) with clasts up to 1.5 m in diameter, and silty clay to clayey silt of probable marine origin. The top of the section consists of sand and sandy pebble gravel. Some beds exhibit loose, sand and pea-size granules, possibly indicative of beach deposit.

Another exposure, closer to the highway, showed sand and gravel. Clasts were subangular to subrounded.

The texture of the material is very variable and restricts usage of the deposit to a source of fill. The deposit is interpreted as an ice-contact deposit overlain by fine marine sediments; some marine reworking of the material has taken place.

D.O.T. (1963) examined the property and recommended the material for borrow, subbase and base course aggregate. The Los Angeles abrasion loss was 23.5%. It was noted that the grading was slightly erratic and that there was an excess of fines. Clay and rocks (till?) were encountered in some of the test excavations.

Two other deposits, located 2.0 km and 2.5 km north-northeasterly of G3-18 have been worked in the past but are now abandoned and poorly exposed. The

MECHANICAL ANALYSIS:

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.4mm	600µm	300µm	150µm	75µm
% passing	a	99.0	97.9	94.1	82.3	60.3	45.0	24.3	12.0	4.4	2.3
	b										
	c										

LITHOLOGIC ANALYSIS: N.A.

Unsound Lithotypes	%	Sound Lithotypes	%

ESTIMATION OF RESERVES:

total deposit area (hectares)	area workable (hectares)	average thickness (metres)	recoverable reserves (m^3) probable
			SEE G3-19

LOCATION #: G3-18 (cont'd)

surface expression is hummocky and shallow diggings expose sandy pebble gravel and sand. The potential of these ice-contact deposits is moderate and much textural variability can be expected.

LOCATION #:	G3-19	NTS:	21 G/3
Type of Deposit:	Marine/Ice-contact	County:	Charlotte
Exposure Type:	Pit	Parish:	St. David
Status:	Active on demand	UTM:	412 080

SECTION DESCRIPTION & COMMENTS:

The main face in the deposit measured 20 m high and was badly slumped. Capping the sections is a 1 m bed of olive brown clayey silt to silty clay, blocky where weathered but dense and stiff when fresh. Some pebbles and small cobbles occur within this unit which is probably of marine origin.

Laterally, sections show well stratified and well sorted beds of medium sand and cobbly pebble gravel. The sample was obtained from an area showing signs of recent activity. A few small boulders were noted but the maximum clast size seen in sections was 20 cm.

Silt and clay are common and overlie the deposit. This overburden is thicker in some places where it fills depressions in the ice-contact body. The core of the deposit is a good potential source of sand and gravel but much has already been removed. Crushing has taken place in the past and an asphalt plant was used at one time.

D.O.T. (1968) examined and sampled the site and reported the following:
Percentage finer than 75µm: range, 1.4% to 31.2%; mean, 4.0%
Los Angeles abrasion loss: range, 25.1% to 26.5%; mean, 25.9%

D.O.T. noted that the deposit was characterized by erratically graded sands and silty sands, with as much as 31.2% passing the 75µm sieve. The coarse to

MECHANICAL ANALYSIS:

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.4mm	600µm	300µm	150µm	75µm
% passing	a	91.7	87.3	77.5	70.6	62.5	52.5	28.4	11.1	3.8	1.9
	b										
	c										

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 34%	Sound Lithotypes 66%
Sandstone 19; Weathered 3; Slate 3; Schist 3; Chert 2; Siltstone 2; Mafic intrusive 1; Felsic intrusive 1	Sandstone 31; Metasediment 16; Quartzite 12; Quartz 4; Felsic intrusive 2; Mafic intrusive 1

ESTIMATION OF RESERVES:

total deposit area (hectares)	area workable (hectares)	average thickness (metres)	recoverable reserves (m^3) probable
140	18	5	900,000

LOCATION #: G3-19 (cont'd)

medium grained material had top particle size of 4 to 7.5 cm and was poorly graded with excessive coarse and intermediate size sand fraction; some samples showed an excess of fines. Although the texture of the deposit was found to be variable, the potential for coarse grained gravel was said to be good and the material was recommended for borrow and borderline subbase.

Estimation of reserves have been calculated for the entire Benson Corner ice-contact complex. In places, especially north of Highway 1, the texture of the material may be poor and more akin to ablation till (see G3-18). The best source of material remains the esker crest which is outlined by the many pit workings. A variable thickness of silt and clay overburden commonly overlie the deposit. Bedrock may occur at shallow depths near the periphery of the deposit.

LOCATION #: G3-20 NTS: 21 G/3

Type of Deposit: Marine/Ice-contact County: Charlotte

Exposure Type: Pit Parish: St. David

Status: Active on demand UTM: 416 079

SECTION DESCRIPTION & COMMENTS:

The active face is 7 m high and displays moderately sorted sandy pebble gravel beds. About 0.5 to 1.0 m overburden caps the section. Laterally, the texture of the deposit changes to beds of well sorted medium sand (sample B) that are underlain by cobble gravel. The western face shows olive brown silty clay, of probable marine origin, fractured where weathered but dense and stiff where fresh. The north face is 10 m high and mostly slumped. Slumped beds of poorly stratified sand and gravel (marine reworked?) are exposed at the top of the section.

Clasts are generally subrounded to rounded and the silt content is low except along the west face. The maximum clast diameter observed was 50 cm.

Several other pits have been opened in the deposit but most are now inactive or abandoned.

D.O.T. (1961, 62, 69) sampled the deposit. Laboratory test results are as summarized follows:
Percentage finer than 75µm: range, 1.4% to 14.6%; mean, 3.3%
Los Angeles abrasion loss: range, 22.9% to 25.5%; mean, 24.0%

D.O.T. data show the material to be very variable throughout. Some parts of the deposit are well graded and have been recommended for borrow, subbase

MECHANICAL ANALYSIS:

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.4mm	600µm	300µm	150µm	75µm
% passing	a	94.4	91.6	73.5	59.2	45.3	32.1	9.8	2.7	1.7	1.1
	b			100.0	99.8	99.2	96.0	52.8	9.2	2.0	1.0
	c										

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 34%

Sandstone 21; Weathered 5; Slate 4; Schist 3; Chert 1

Sound Lithotypes 66%

Sandstone 33; Quartzite 12; Metasediment 9; Felsic intrusive 7; Mafic intrusive 3; Quartz 1; Siltstone 1

ESTIMATION OF RESERVES:

total deposit area (hectares)	area workable (hectares)	average thickness (metres)	recoverable reserves (m^3) probable
			SEE G3-19

LOCATION #: 83-20 (cont'd)

and base course aggregate. Other parts were only suitable for borrow. Proposed use was for sub-base (1969) and asphaltic concrete mixtures (1962). Crushing was suggested to improve the texture of some poorly graded zones.

LOCATION #: G3-21 NTS: 21 G/3

Type of Deposit: Ice-contact County: Charlotte

Exposure Type: Pit Parish: St. David

Status: Active on demand UTM: 442 075

SECTION DESCRIPTION & COMMENTS:

Section at entrance

2.0 m Sand and Gravel: Moderately sorted sand and pebble gravel.

1.0 m Sand: Fine sand to silty sand.

2.0 m Silty Clay: Stiff, oxidized, silty clay gradually changing to a dense grey malleable silty clay (probably marine). The silty clay is banded. To the south, laterally, the silty clay grades into laminated silt and silty sand.

6.0 m Slump Covered: Silty clay, probably overlying sand and gravel.

Section near entrance to active part of the pit

A 6 m section exhibits a dense and compact core of bouldery stony sandy silt till. Clasts measure up to 60 cm in diameter. This unit grades laterally, to the east, into a massive pebble gravel bed; pebbles are commonly coated with silt. To the west, the till core grades into poorly sorted sand and pebble gravel, with some cobbles; where observed, bedding is disturbed.

Main section

The lower lift exhibits 4 m of well sorted, well stratified, fine to medium pebble gravel and sand. Sample A was obtained from a sandy horizon. The total height of the lower lift section is 8 m.

MECHANICAL ANALYSIS:

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.4mm	600µm	300µm	150µm	75µm
% passing	a	99.1	97.3	89.0	81.1	68.8	56.5	33.5	14.3	4.7	2.2
	b	80.7	63.0	31.3	20.2	13.0	9.7	5.9	3.7	2.3	1.2
	c										

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 30%

Siltstone 16; Sandstone 8; Schist 4; Weathered 2

Sound Lithotypes 70 %

Sandstone 38; Quartzite 12; Siltstone 9; Metasediment 7; Felsic intrusive 4

ESTIMATION OF RESERVES:

total deposit area (hectares)	area workable (hectares)	average thickness (metres)	recoverable reserves (m^3) probable
17	2.5	10	250,000

LOCATION #: G3-21 (cont'd)

The second lift exposed an 11 m face showing a core of moderately well sorted, clast-supported, coarse pebble gravel (sample B), overlain by 4 m of well sorted, stratified, medium to fine sand and sandy pebble gravel beds. At the top, a thin horizon of loose, well sorted sand was noted; it may represent marine reworking of the deposit. The lower part of the section was obscured by slumping. The south face shows laminated fine sand and silty sand in the top part of the section while the north face displayed beds of coarse cobble gravel.

The texture is very variable throughout the deposit and typical of an ice-contact deposit. Material varies from coarse bouldery silt till to finely laminated sand and silty, clayey marine sediments. Thick sections expose moderately sorted sand and gravel. Sand is abundant in many parts of pit, especially near the top of the sections.

A stockpile of fine crushed aggregate was produced on site. D.O.T. (1962, 1968) tested the deposit and noted that it was characteristically "fairly well to somewhat erratically graded". Sampling reflected this and showed that the material commonly contained excessive proportions of coarse and intermediate sand size fractions. Some samples also showed an excess of fines (passing the 75μm sieve).

Test results indicated:
Percentage finer than 75μm: range, 1.9% to 10.4%; mean, 3.5%
Los Angeles Abrasion loss: range, 20.8% to 22.3%; mean, 21.8%

More than half of the samples were classified as 2A, E or C grade aggregate; recommended use was for borrow, subbase and as a source of soil filter material.

LOCATION #:	G3-22	NTS:	21 G/3
Type of Deposit:	Esker	County:	Charlotte
Exposure Type:	Pit	Parish:	St. Croix
Status:	Inactive	UTM:	459 116

SECTION DESCRIPTION & COMMENTS:

0.5 m Overburden: Oxidized fine pea size gravel and coarse sand (probable marine reworking of the esker crest).

1.0 m Gravel and Sand: Coarse cobbly pebble gravel to sandy pebble gravel. Clasts are subrounded and measure up to 20 cm in diameter (sample A).

1.0 m Sand: Well sorted and well bedded medium to coarse sand (sample B).

1.0 m Slump Covered: Assumed to be mainly sand.

The esker ridge has been intensively worked. Gravel can be expected in the core but sand is the dominant element displayed in the sections. A few small boulders were noted along the talus slopes and in the pit. Small amounts of silt were found at the top of some sections. Maximum section height in pit was 6 m.

D.O.T. (1962, 1963) sampled the deposit and obtained the following results:
Percentage finer than 75µm: range, 1.6% to 5.1%; mean, 2.8%
Los Angeles Abrasion loss: 24,9%, 25,6% and 25,8%

MECHANICAL ANALYSIS:

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.4mm	600µm	300µm	150µm	75µm
% passing	a	92.7	87.5	66.3	41.2	22.6	13.6	7.2	4.8	2.8	1.0
	b		100.0	97.8	90.7	77.6	51.9	13.4	5.6	2.8	1.1
	c										

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 36%	Sound Lithotypes 64%
Sandstone 23; Weathered 5; Schist 5; Slate 3	Sandstone 22; Quartzite 16; Metasediment 12; Felsic volcanic 4; Mafic volcanic 3; Siltstone 3; Felsic intrusive 2; Quartz 2

ESTIMATION OF RESERVES:

total deposit area (hectares)	area workable (hectares)	average thickness (metres)	recoverable reserves (m^3) probable
25	6	4	240,000

LOCATION #: G3-22 (cont'd)

The material was recommended mainly as a source of borrow but parts of the deposit satisfy the requirements for subbase, soil filter and base course aggregate. It was noted that the grading was erratic and that the material was deficient in sizes between 7.5 cm and 0.25 cm.

Reserves estimate was calculated for the entire deposit, including G3-23.

LOCATION #:	G3-23	NTS:	21 G/3
Type of Deposit:	Esker	County:	Charlotte
Exposure Type:	Pit	Parish:	St. Croix
Status:	Active on demand	UTM:	460 111

SECTION DESCRIPTION & COMMENTS:

Active Face, north of main pit

A 3 m high section exhibits dessicated silty clay at the top grading downward to more sandy material. No gravel beds were observed but some clasts occur with the sand and silty clay; one 1.5 m granite boulder was noted. The clay and silt are laminated and the sand is well sorted.

Main pit area

This portion of the esker has been worked intensively. Large boulders (up to 2.5 m across) stand on the pit floor. Sections generally expose fine sandy and silty material. Marine reworking of the upper beds is suggested. The core of the deposit is more gravelly.

MECHANICAL ANALYSIS: Wet sieve

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.4mm	600µm	300µm	150µm	75µm
% passing	a		100.0	99.7	98.2	97.4	96.2	89.8	69.2	37.4	14.7
	b										
	c										

LITHOLOGIC ANALYSIS: N.A.

Unsound Lithotypes	%	Sound Lithotypes	%

ESTIMATION OF RESERVES:

total deposit area (hectares)	area workable (hectares)	average thickness (metres)	recoverable reserves (m^3) probable
			SEE G3-22

LOCATION #: G3-24 NTS: 21 G/3

Type of Deposit: Marine/Ice-contact County: Charlotte

Exposure Type: Pits Parish: St. Croix

Status: Active on demand UTM: 470 000

SECTION DESCRIPTION & COMMENTS:

The main pit is now abandoned. It had been used as a source of fill. Pit faces are high (up to 30 m), steep and slumped except where clay horizons occur. The top of the sections generally consists of laminated fine sand, silty sand and brown fossiliferous silty clay. At the base of the sections, well sorted medium sand is exposed. Other exposures display dirty fine sandy gravel. The stratigraphy is obscured by slumping but the deposit is likely a kame-delta overlain by marine sediments.

At time of visit, only the pit adjacent to the campground was being actively worked. Face height measured 20 m and showed well bedded sand with some grey silty clay and well laminated silt, silty sand and fine sand. Very little gravel was present and only as a few thin beds (10-20 cm thick) occurring within the main sand horizons.

The deposit is dominantly sandy, generally well sorted (sample B), with variable admixtures of silt. Beds of fine sand, silt and clay cap the ice contact core (sample A). Hamilton and Carroll (1975) report the following pebble count: ".... in decreasing order of abundance: acid volcanic rocks, quartz, argillite, shale, basic volcanic rocks, granite, quartzite, greywacke and schist".

MECHANICAL ANALYSIS:

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.4mm	600µm	300µm	150µm	75µm
% passing	a	100.0	99.5	96.9	93.6	91.4	89.8	87.8	85.6	57.0	16.8
	b			100.0	99.6	97.4	91.0	69.1	34.0	7.4	1.7
	c										

LITHOLOGIC ANALYSIS: SEE TEXT

Unsound Lithotypes	%	Sound Lithotypes	%

ESTIMATION OF RESERVES:

total deposit area (hectares)	area workable (hectares)	average thickness (metres)	recoverable reserves (m^3) probable
25	4	13	520,000